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Clendenning

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(54) **HAMMERLESS ATTACHMENT ASSEMBLY FOR A TWO-PART DIGGING TOOTH SYSTEM**

(75) Inventor: **Charles Clendenning**, Broken Arrow, OK (US)

(73) Assignee: **H&L Tooth Co.**, Tulsa, OK (US)

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(51) **Int. Cl.**[7] **E02F 9/28**

(52) **U.S. Cl.** **37/457**

(58) **Field of Search** 37/452, 455, 456, 37/457, 453, 446; 172/701.1, 701.3

(56) **References Cited**

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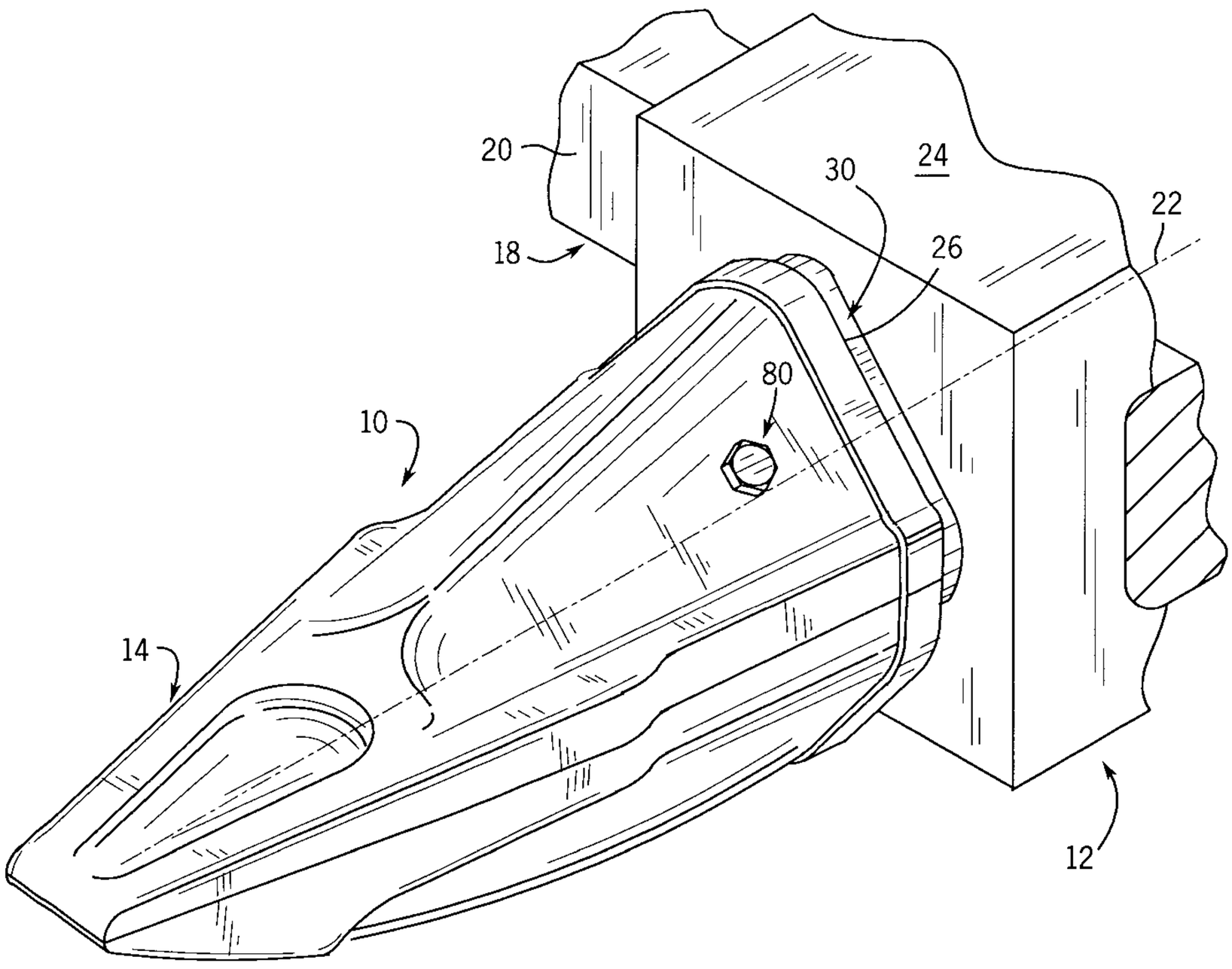
Primary Examiner—Robert E. Pezzuto
(74) *Attorney, Agent, or Firm*—John W. Harbst

26 Claims, 9 Drawing Sheets

(57) **ABSTRACT**

A hammerless attachment assembly for releasably maintaining an adapter and replaceable part or tool of a two-part digging system in operable combination relative to each other. The hammerless attachment assembly includes an insert nonrotatably fitted within a recess defined on a side of the adapter nose portion and a rotatable fastener having a head portion and an externally threaded shank portion. A lengthwise portion of the extends through an opening having a closed margin defined in a side of the tool, with the opening in the side of the tool registering with the internally threaded bore in the insert when the tool is positioned on the adapter nose portion. The externally threaded shank portion of the fastener forms a threaded juncture with the internally threaded bore on the insert such that, in response to rotation of the fastener in a first direction, the insert is drawn toward and, ultimately, tightly clamped against an interior side surface of said blind cavity while remaining, at least partially, within the recess in the adapter thereby releasably maintaining the tool and adapter in operable combination relative to each other. Elastomeric material is disposed in operable combination with the rotatable fastener and the insert for inhibiting contaminants from adversely effecting the threaded juncture between the fastener and the insert thereby facilitating rotation of the fastener in a direction to effect release of the attachment assembly so as to allow repair/replacement of the replacement part of the two-part digging system.



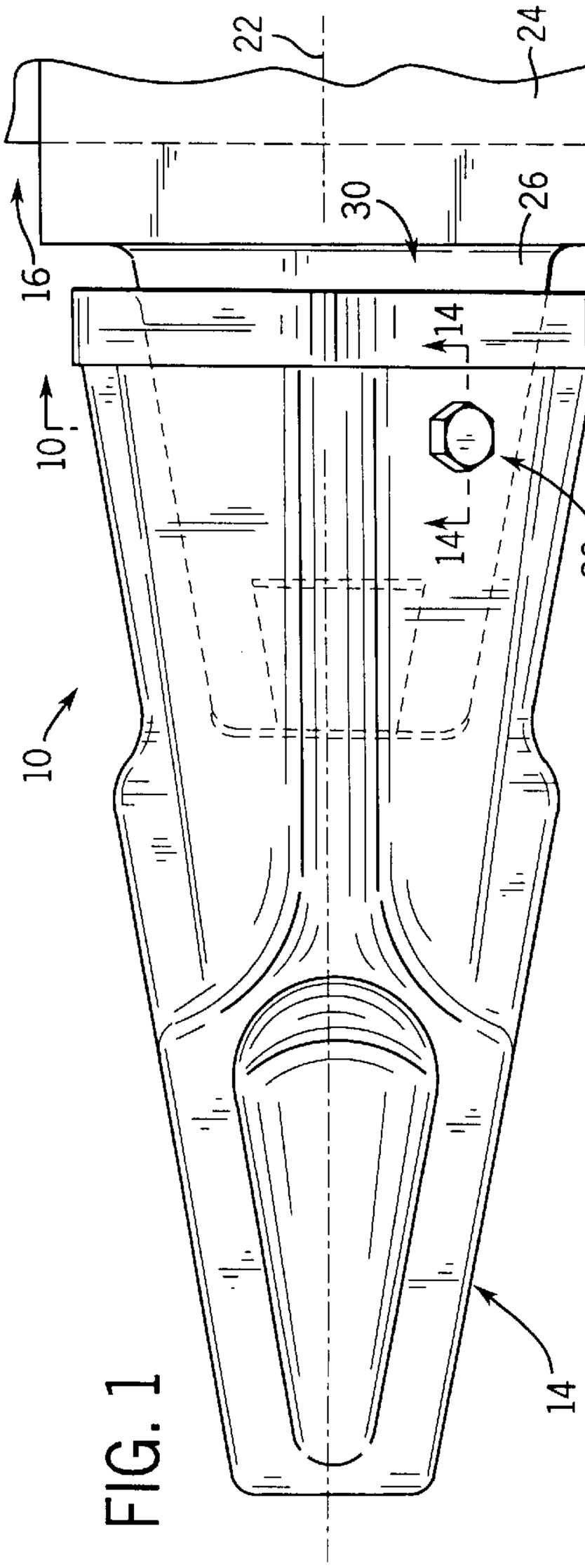

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FIG. 1

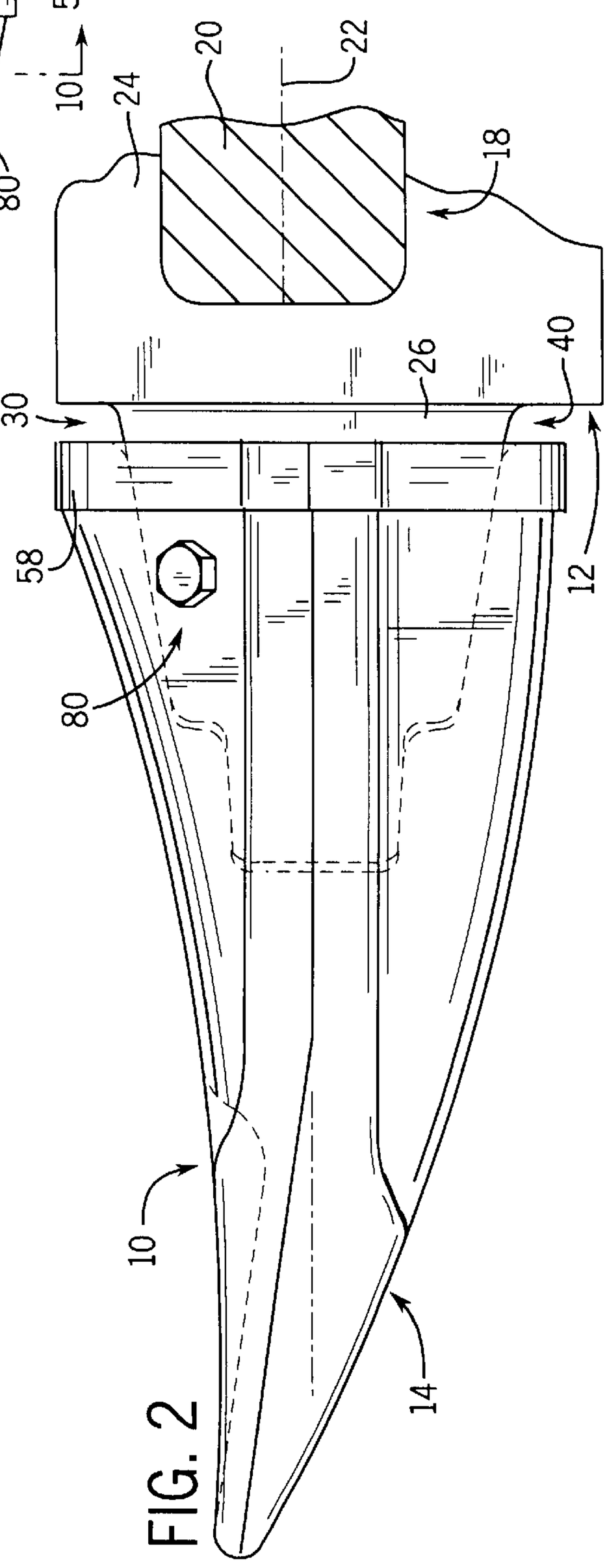
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FIG. 2

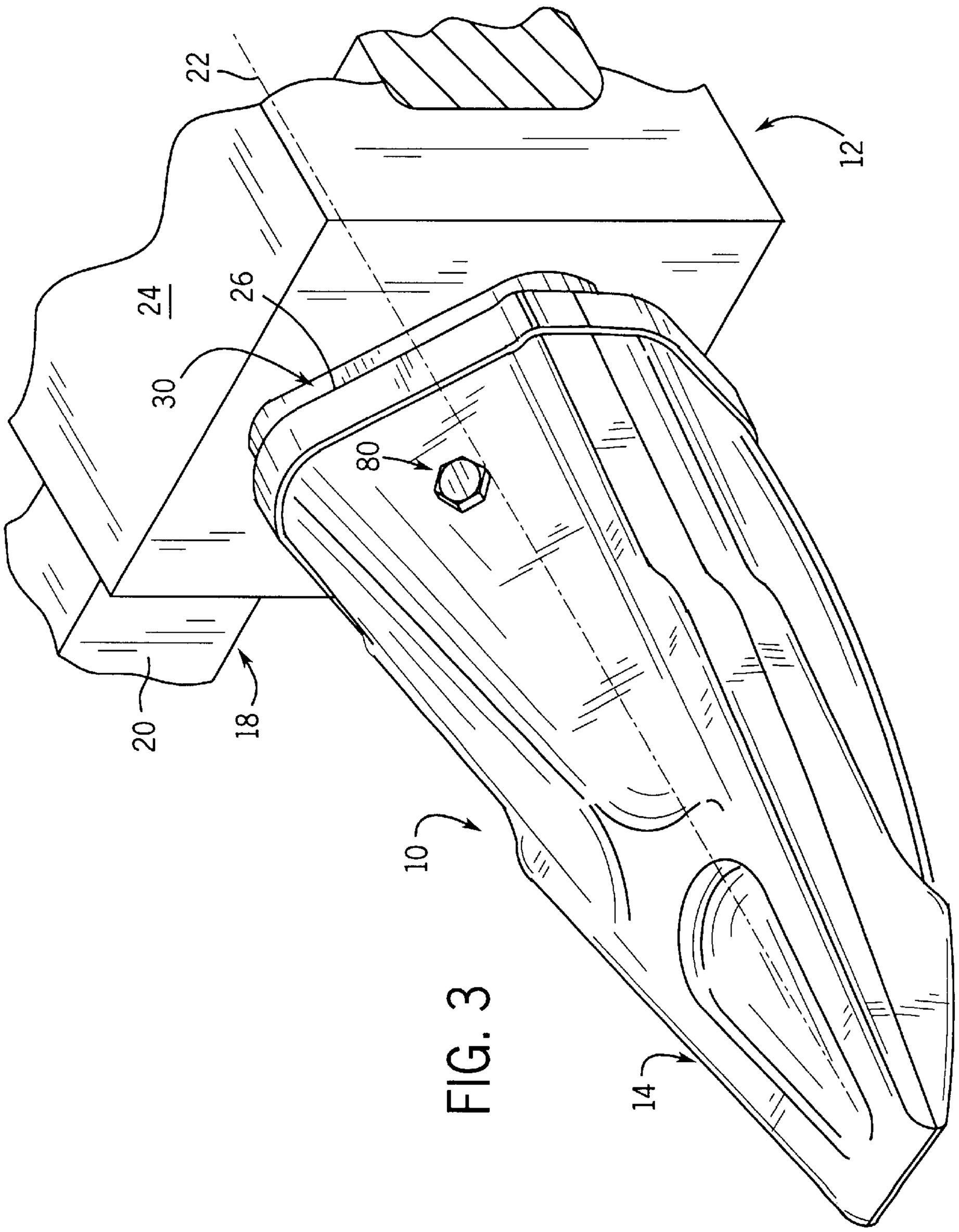


FIG. 3

FIG. 6

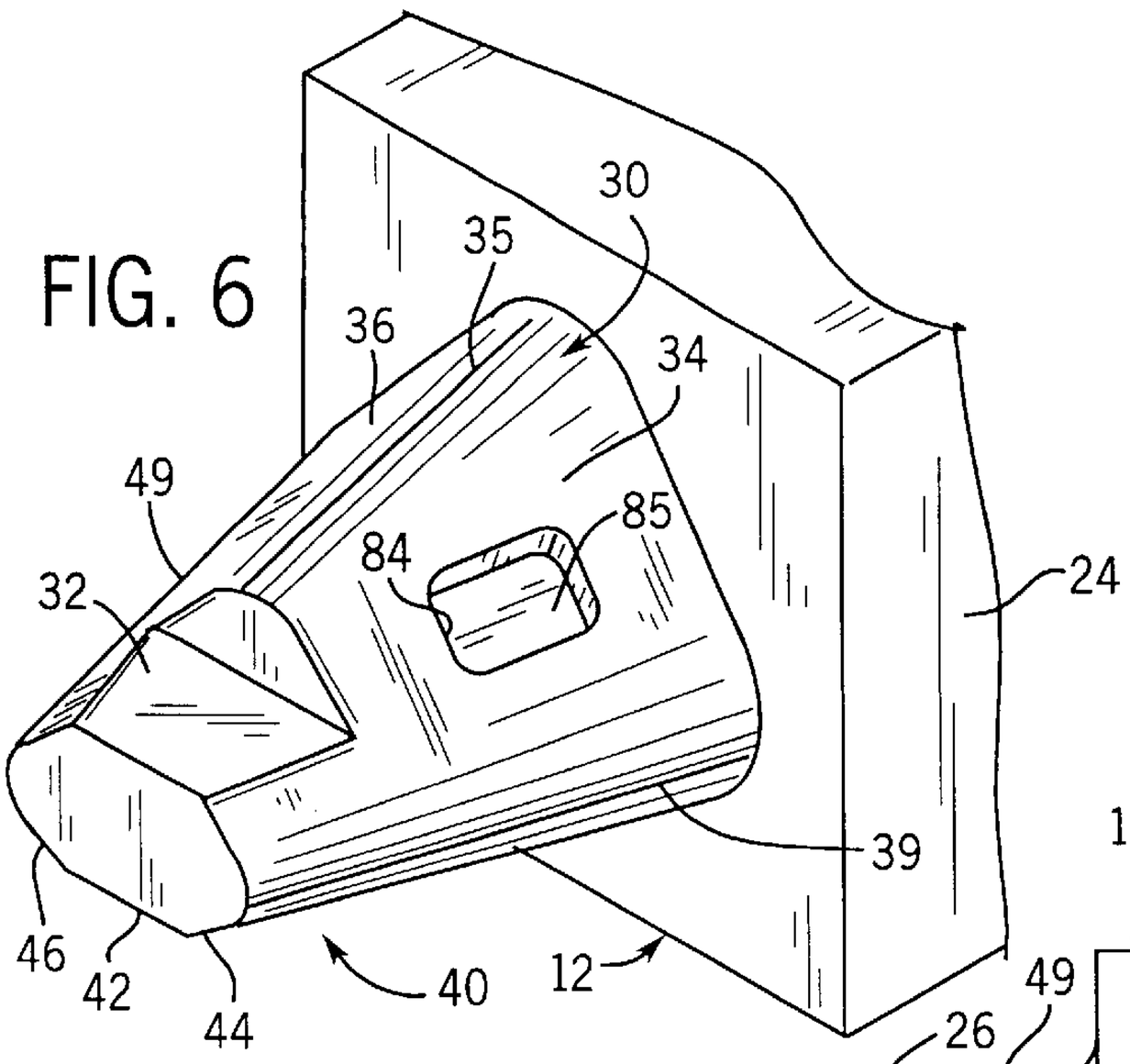
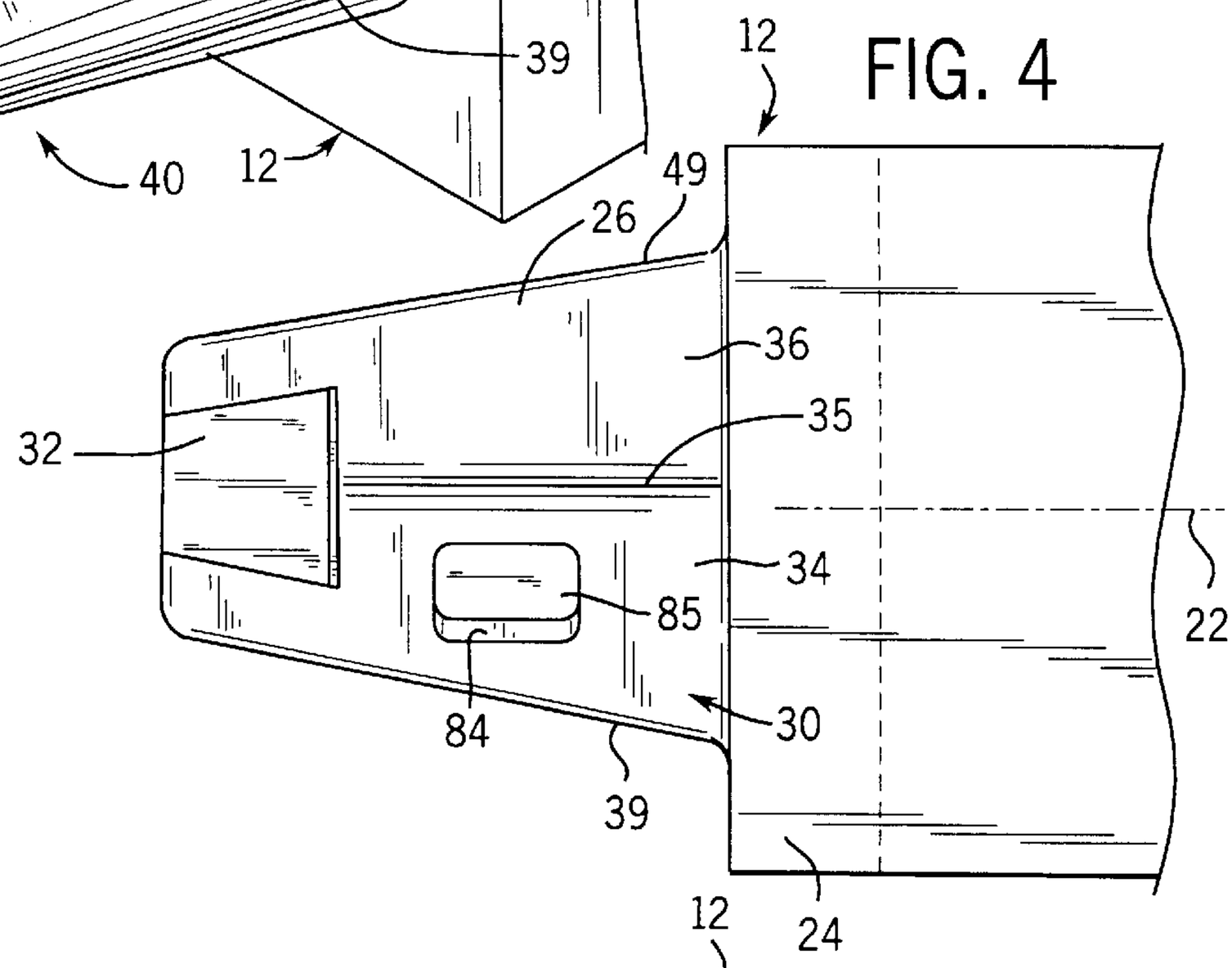


FIG. 4



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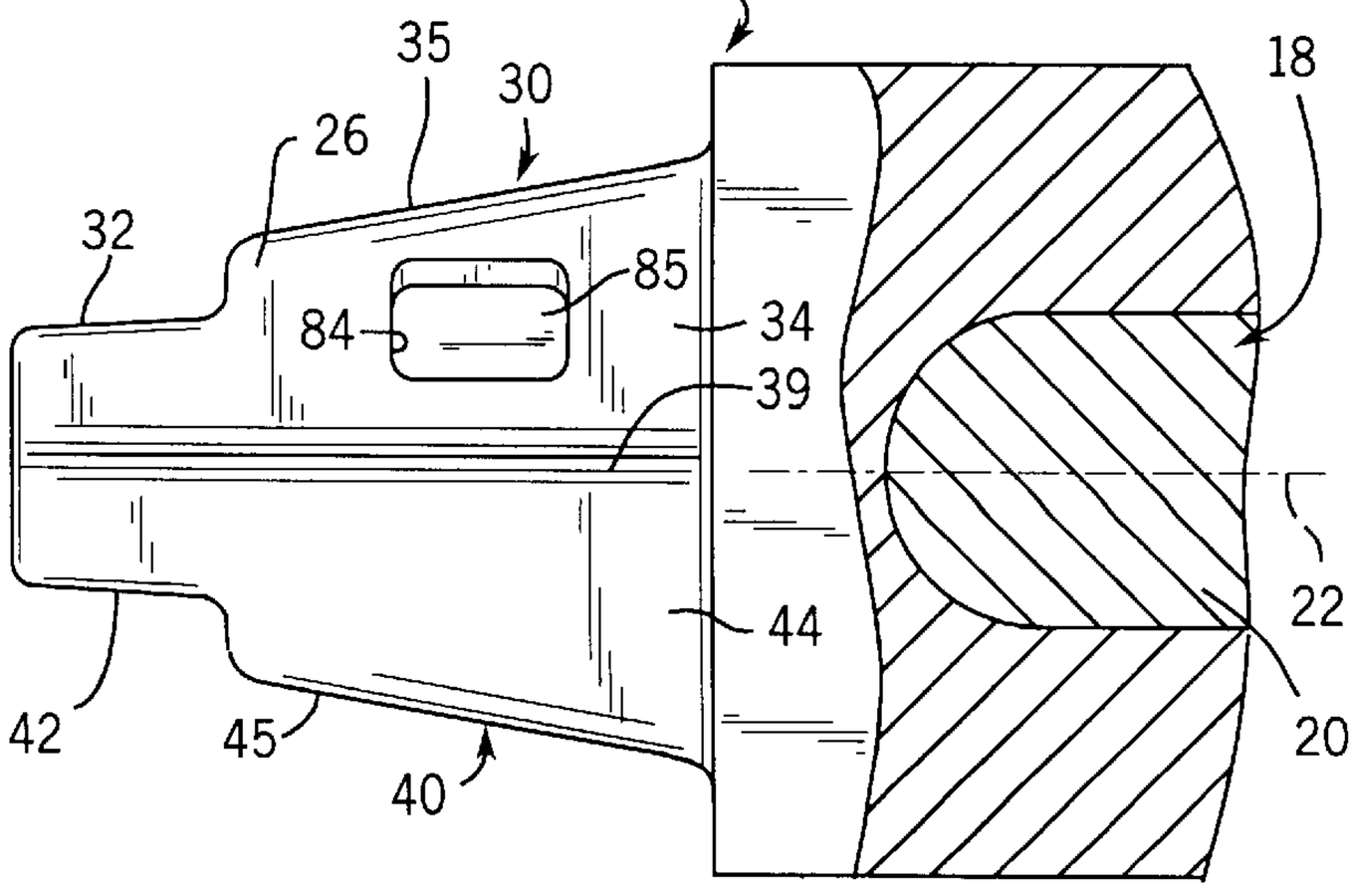

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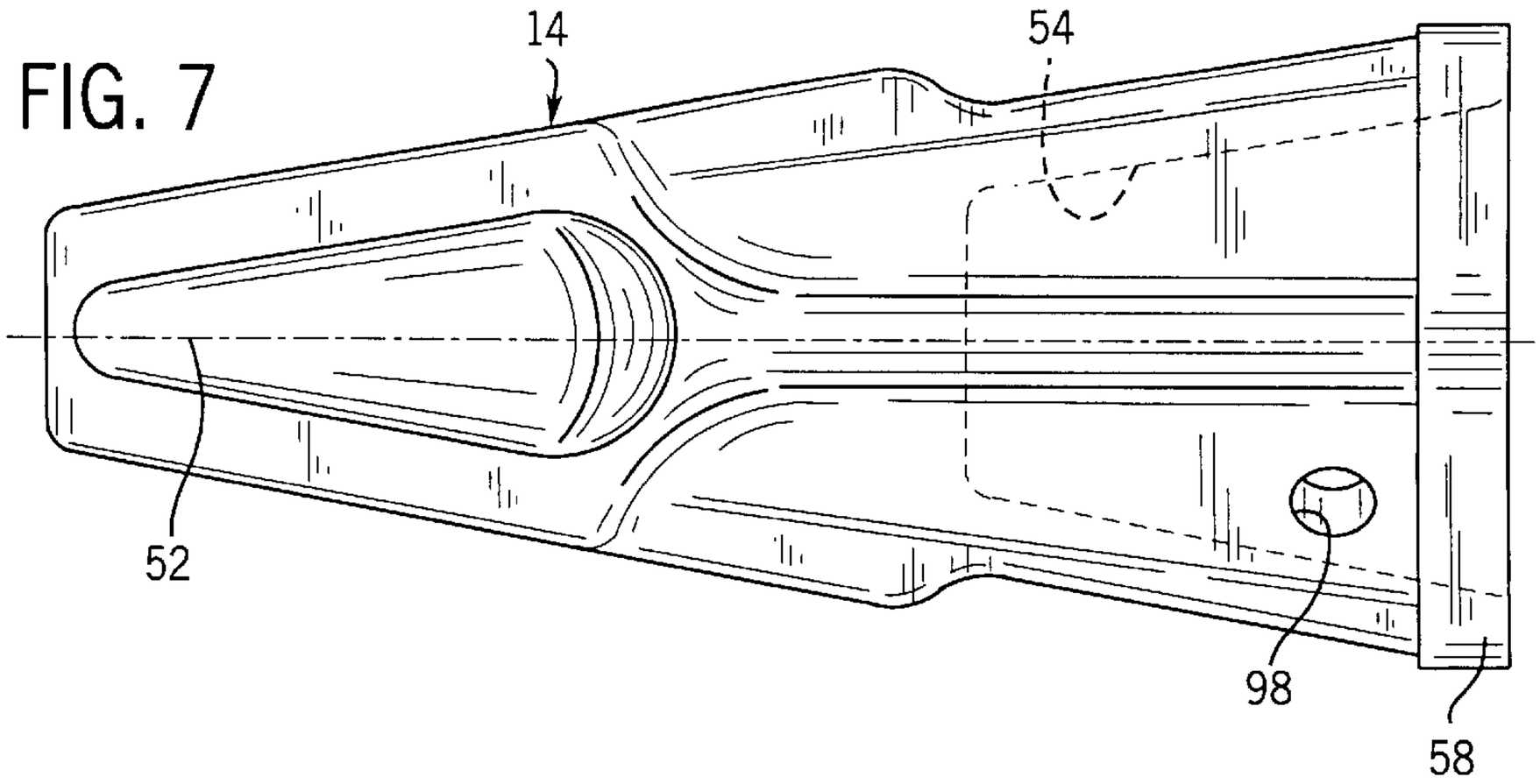

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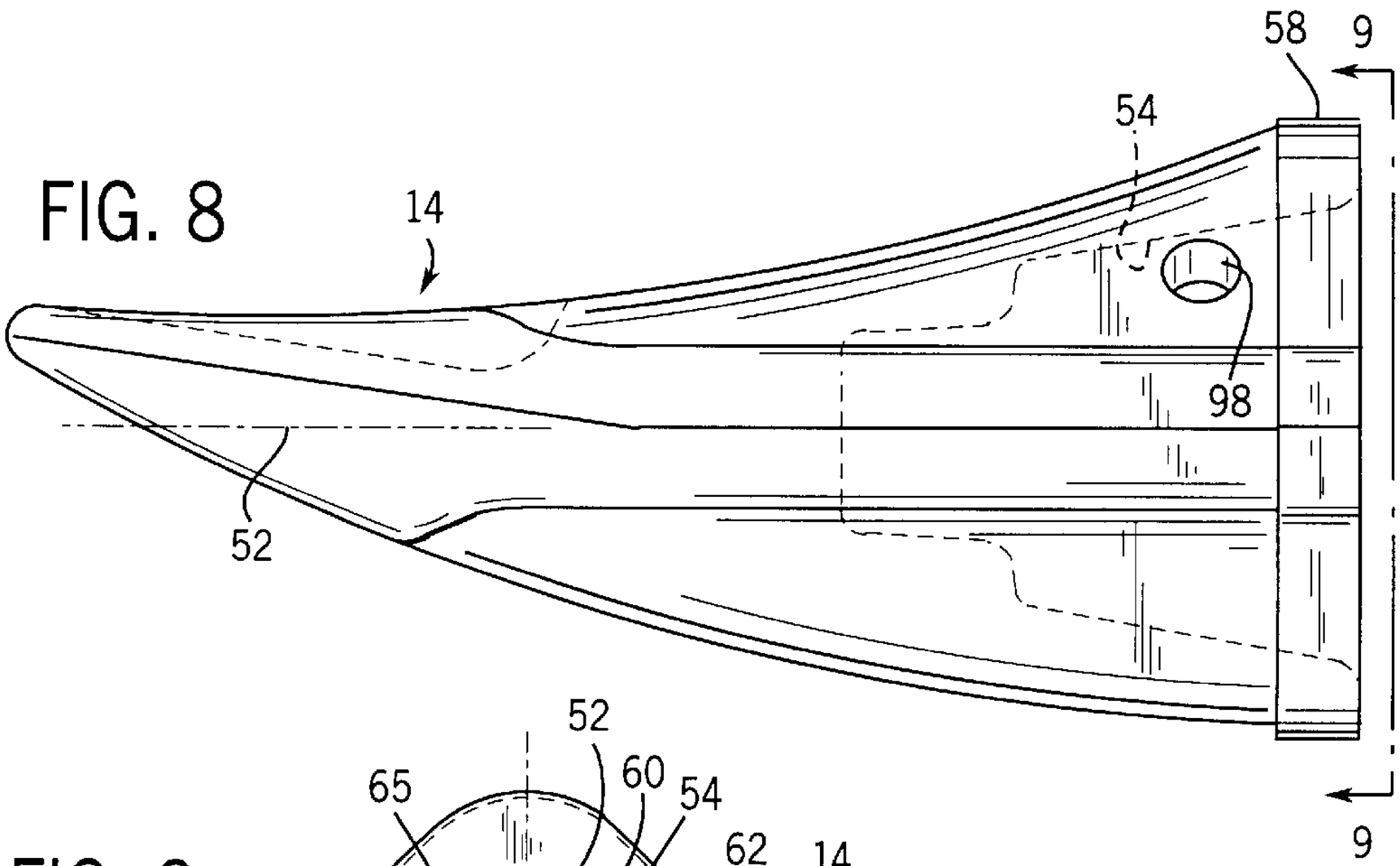

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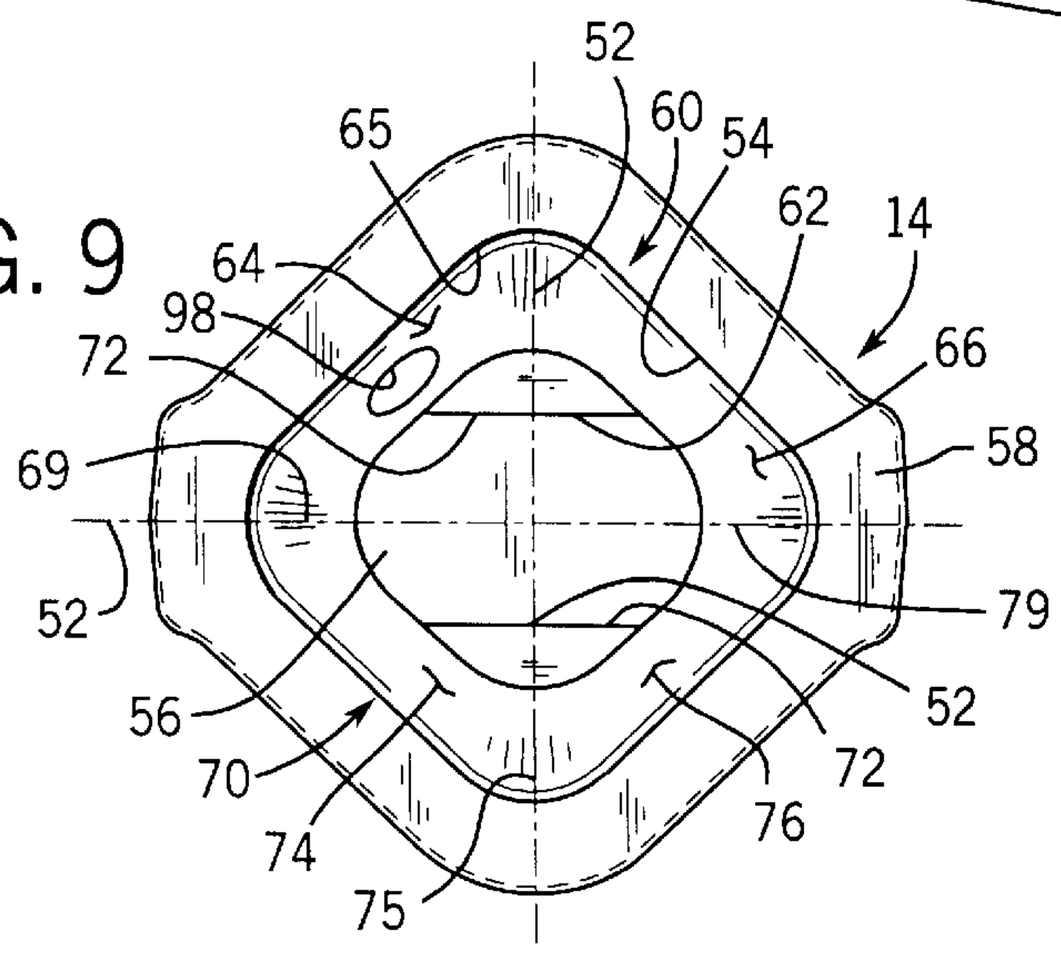


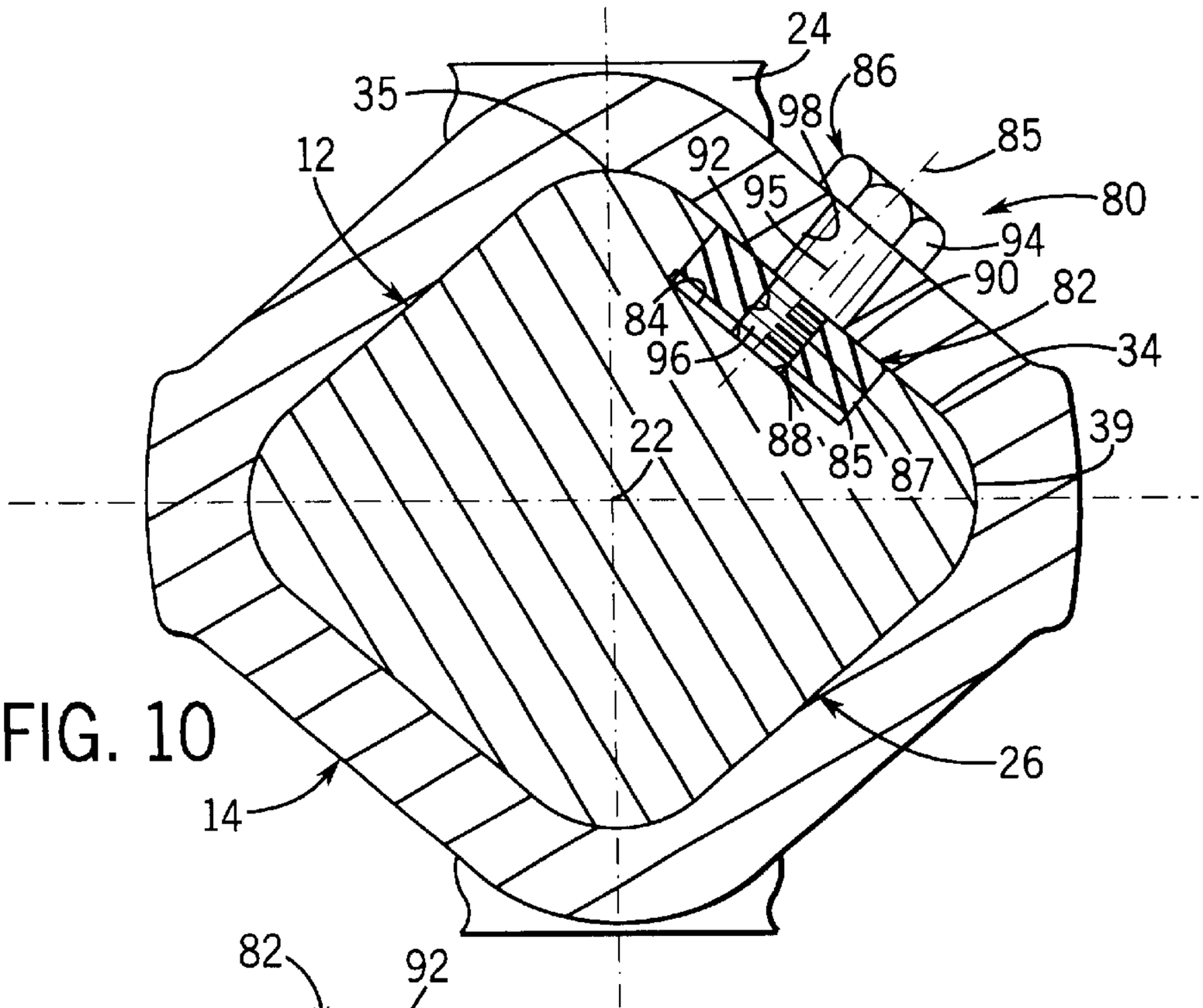


FIG. 10

FIG. 11

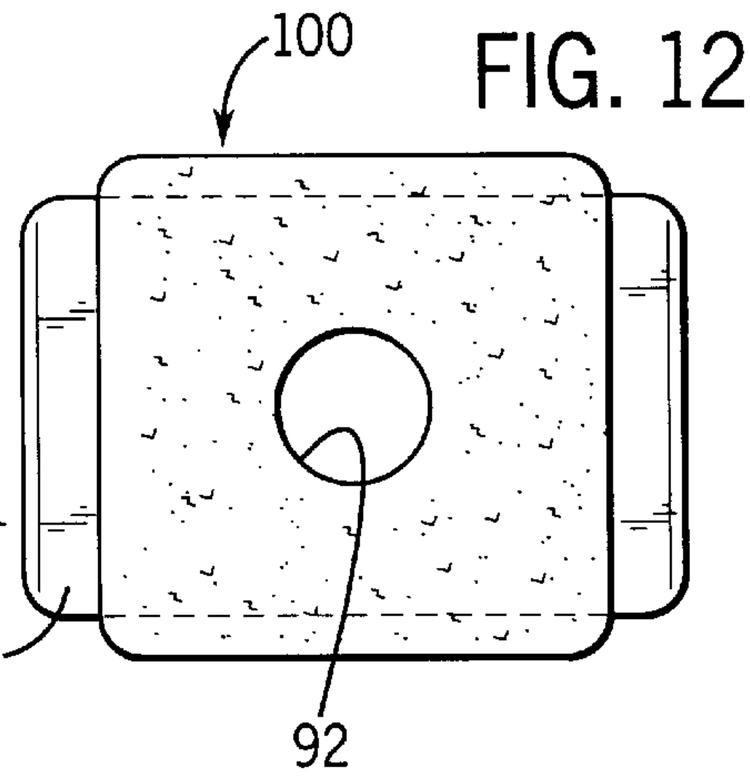
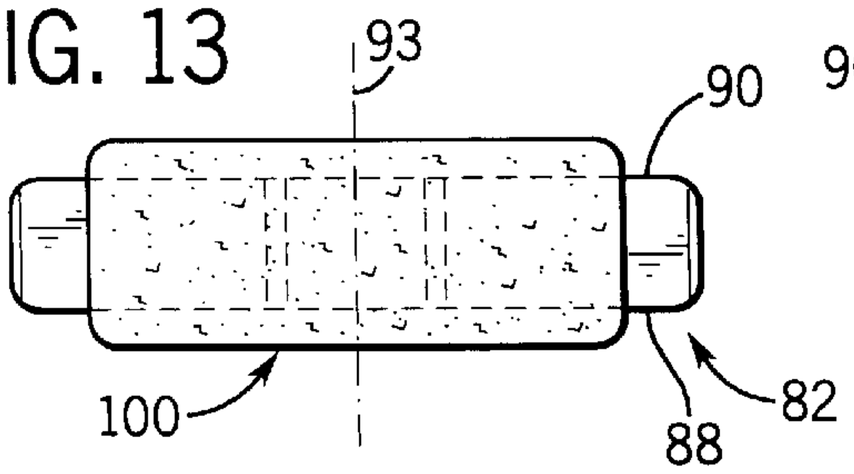


FIG. 12

FIG. 13



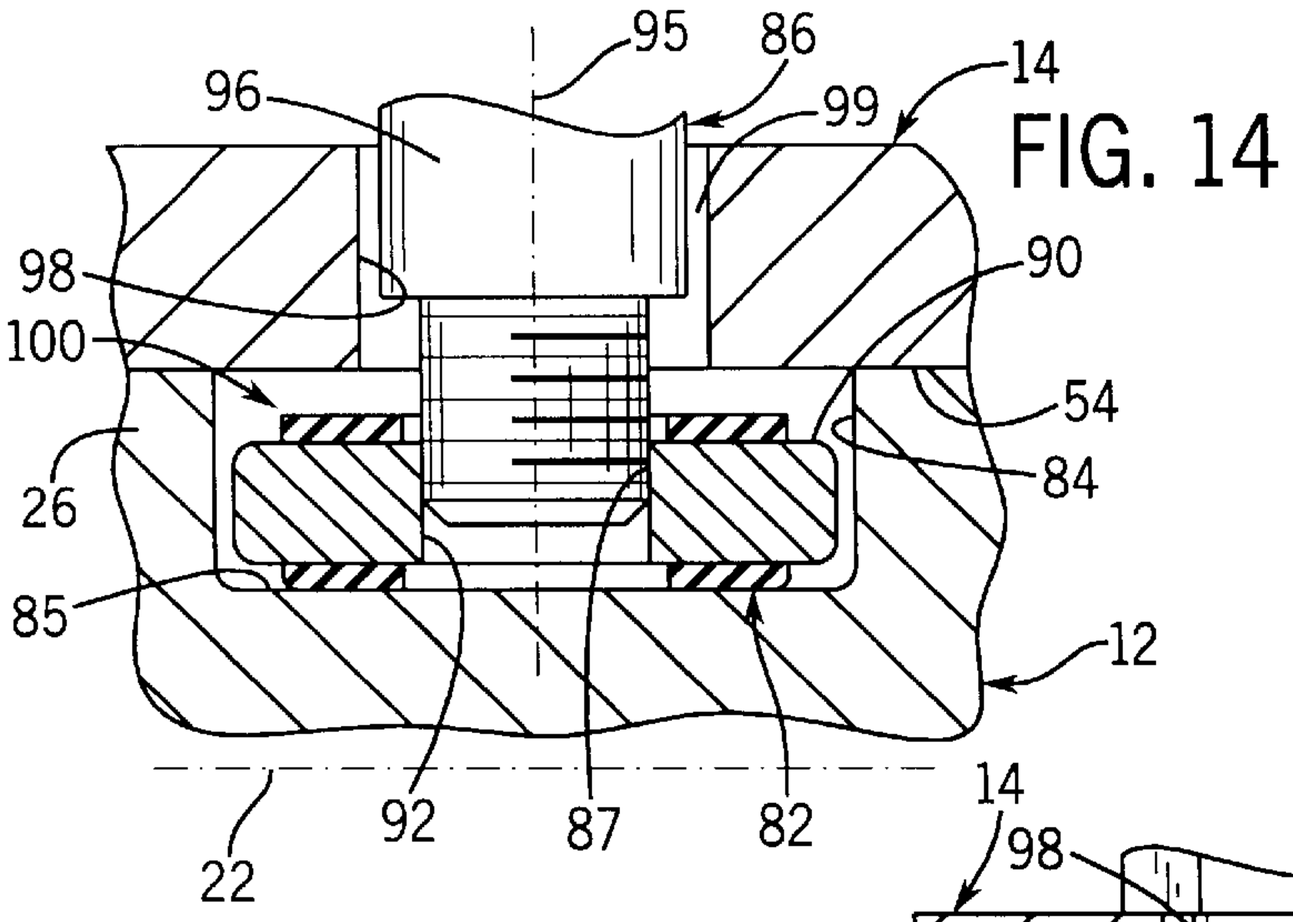


FIG. 14

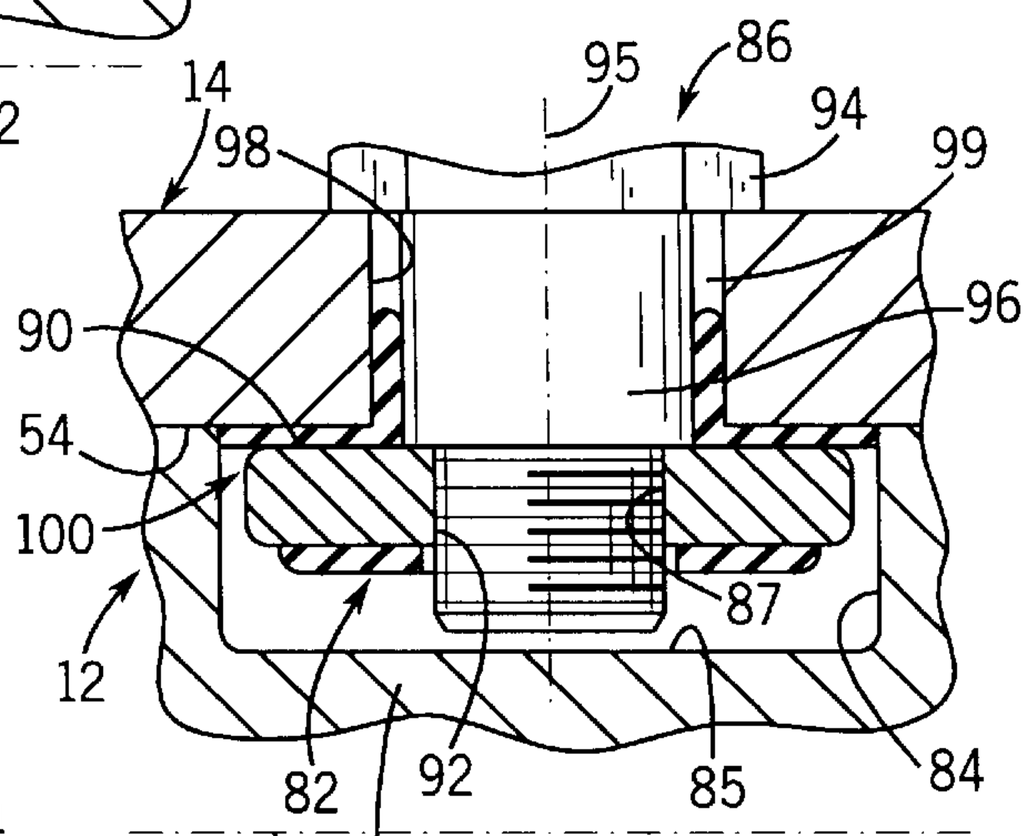


FIG. 15

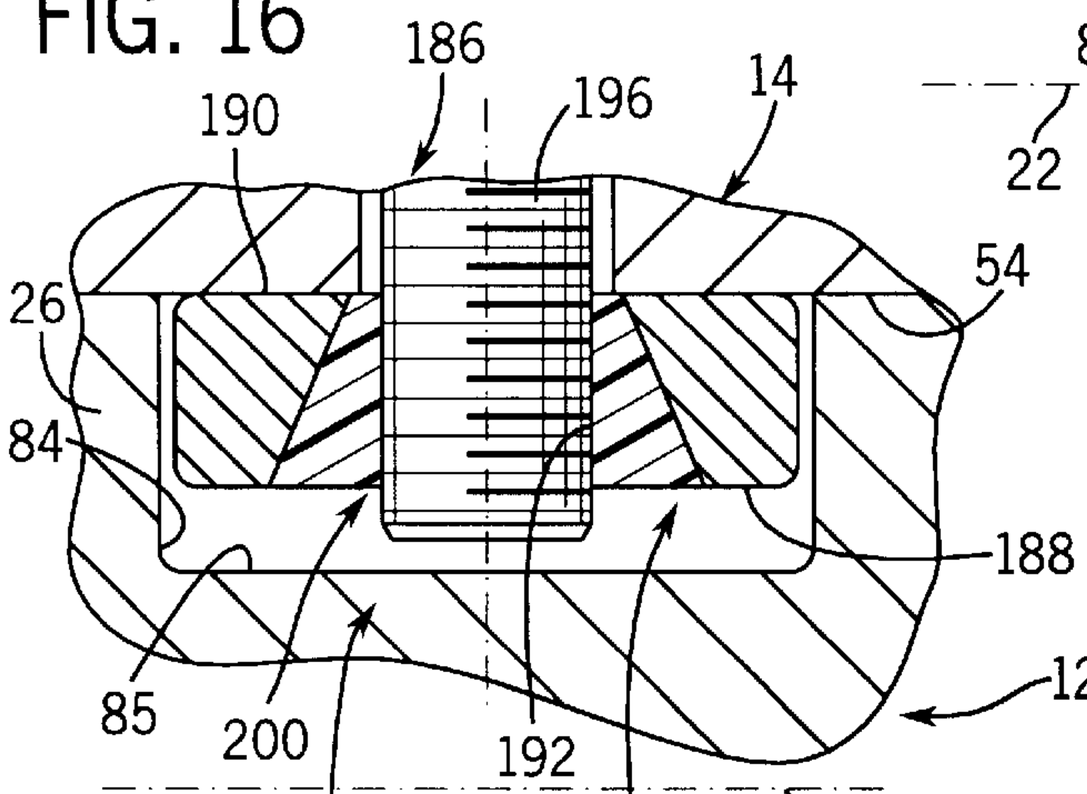


FIG. 16

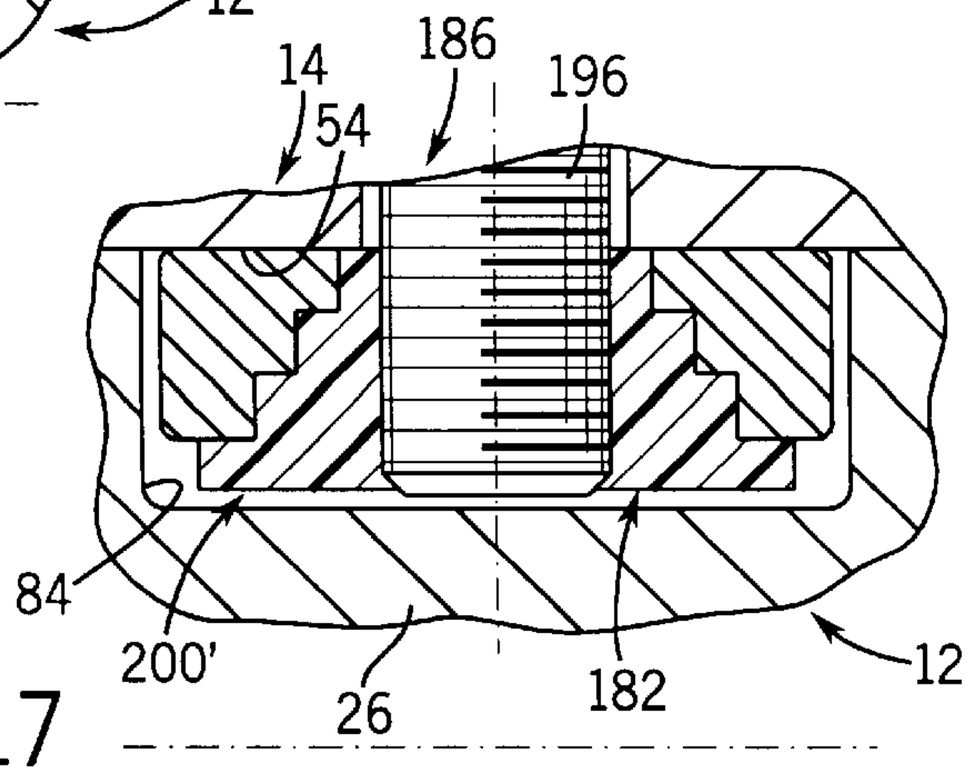
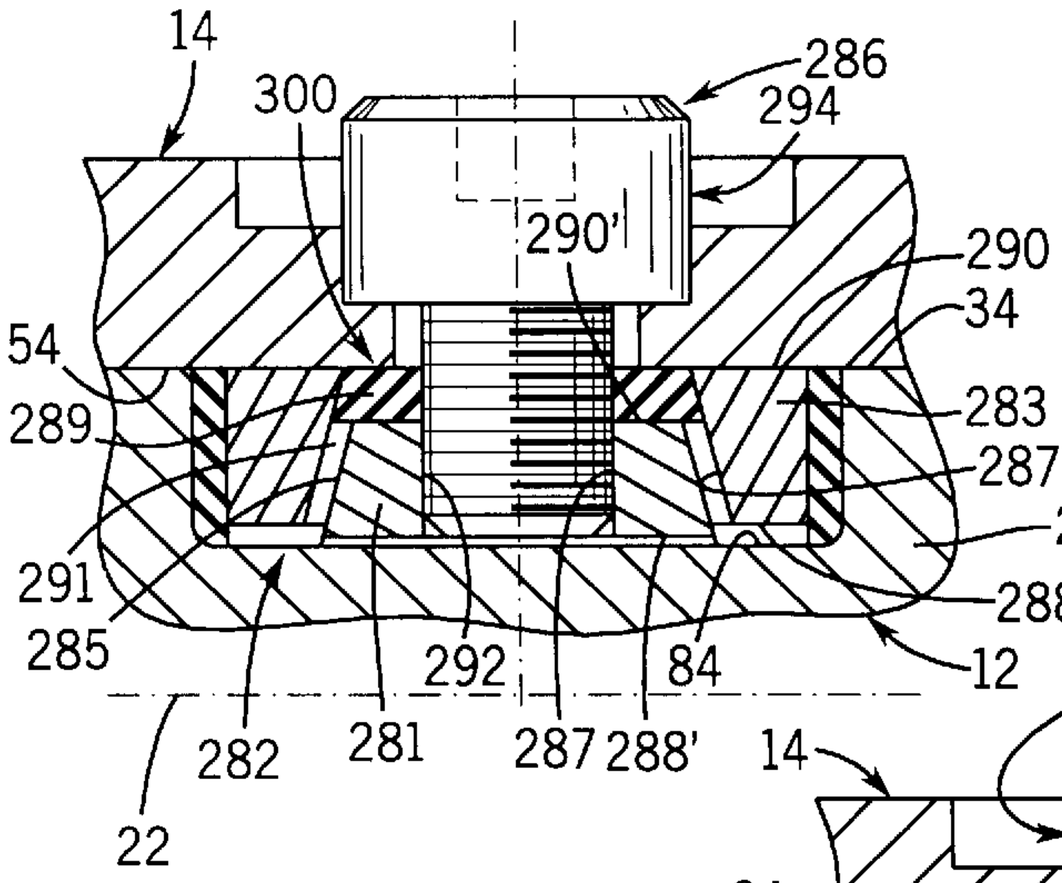


FIG. 17



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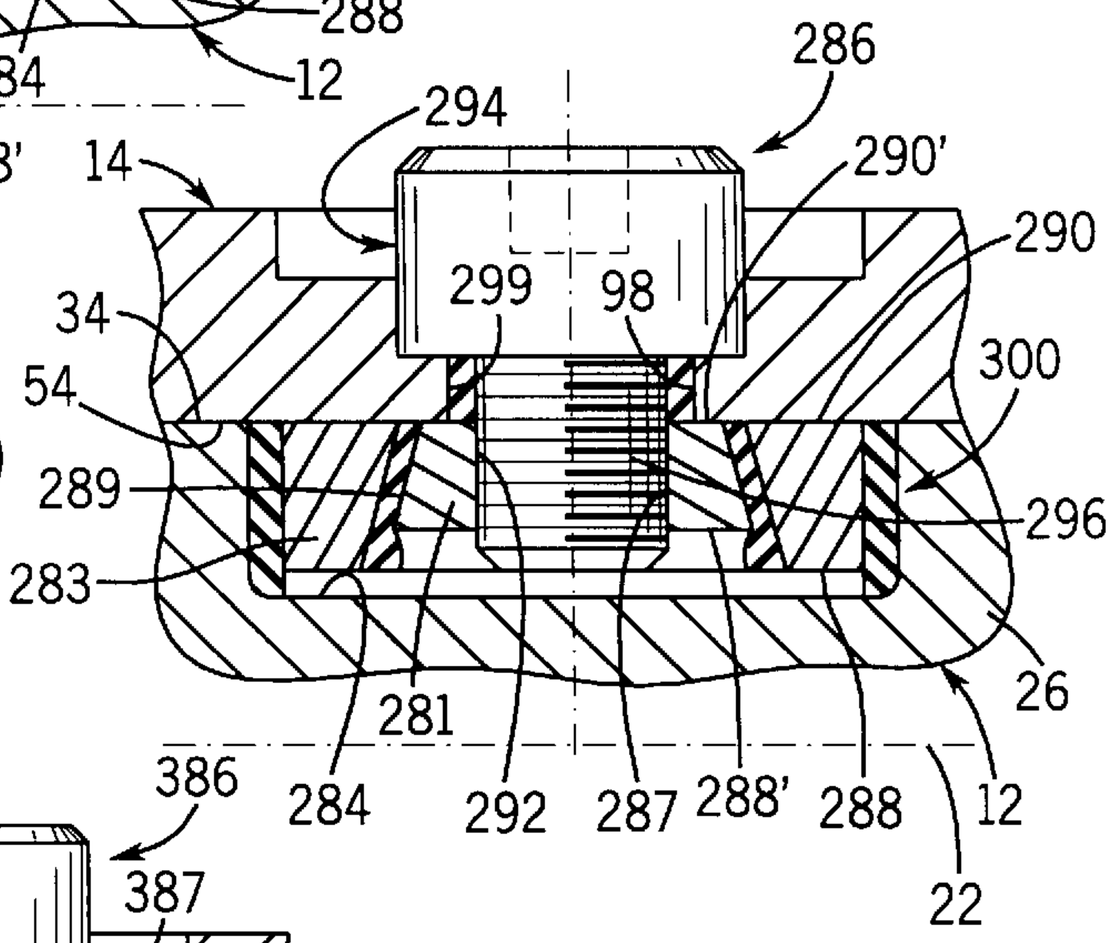
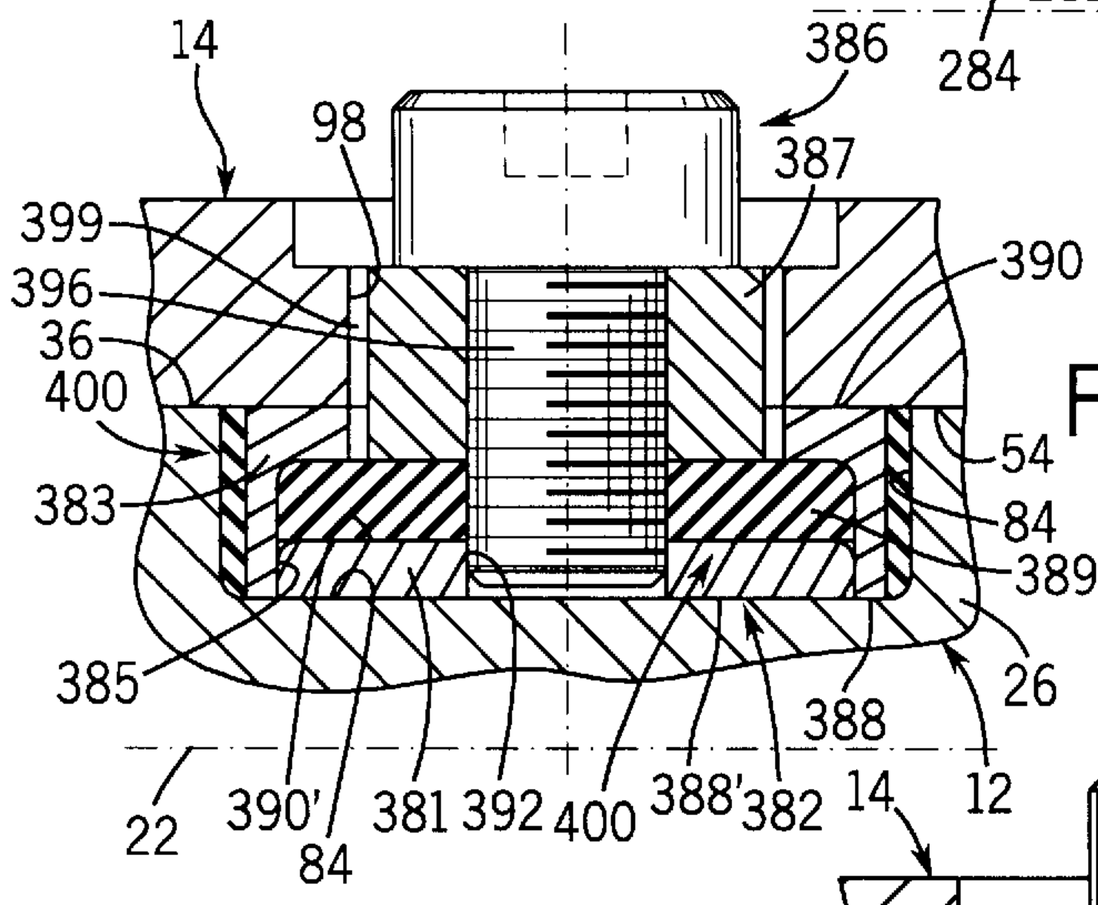


FIG. 19



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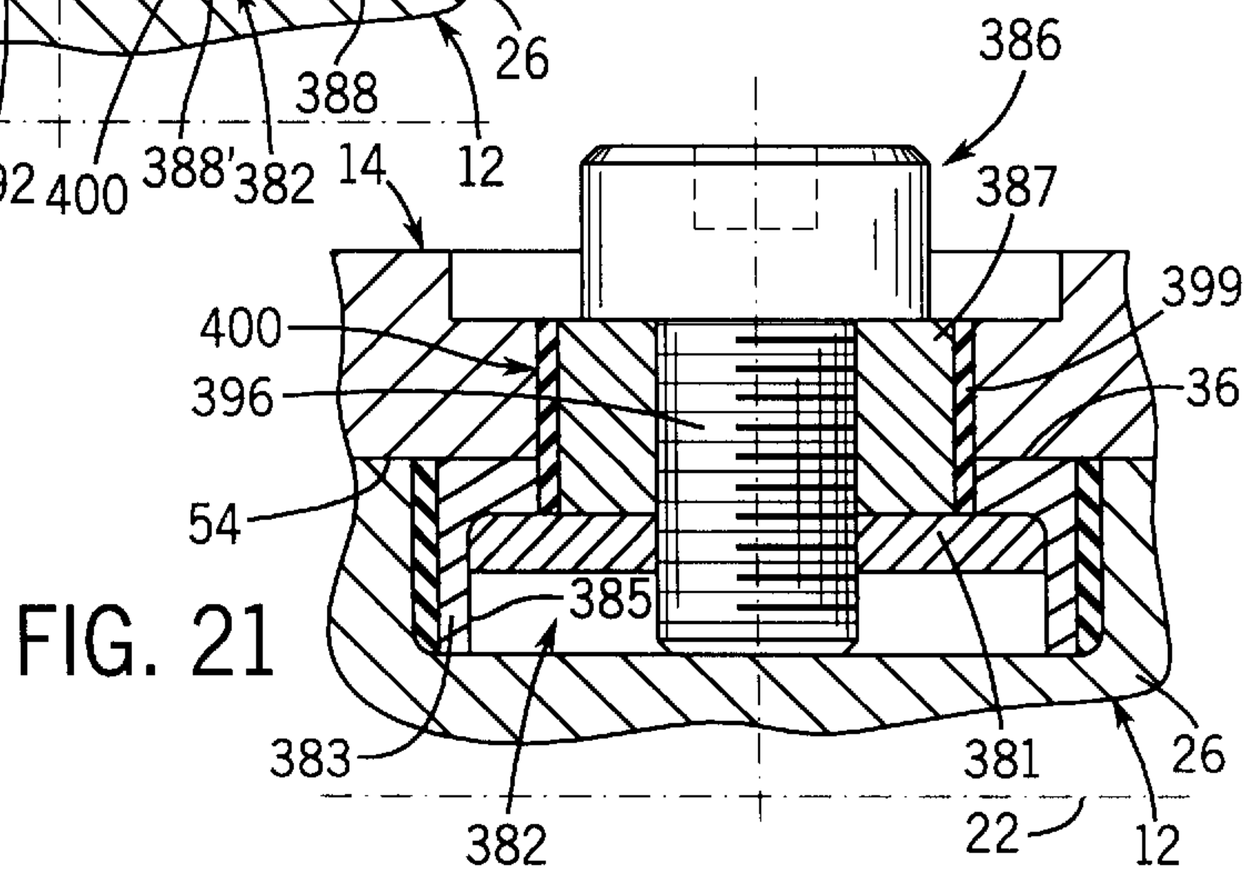
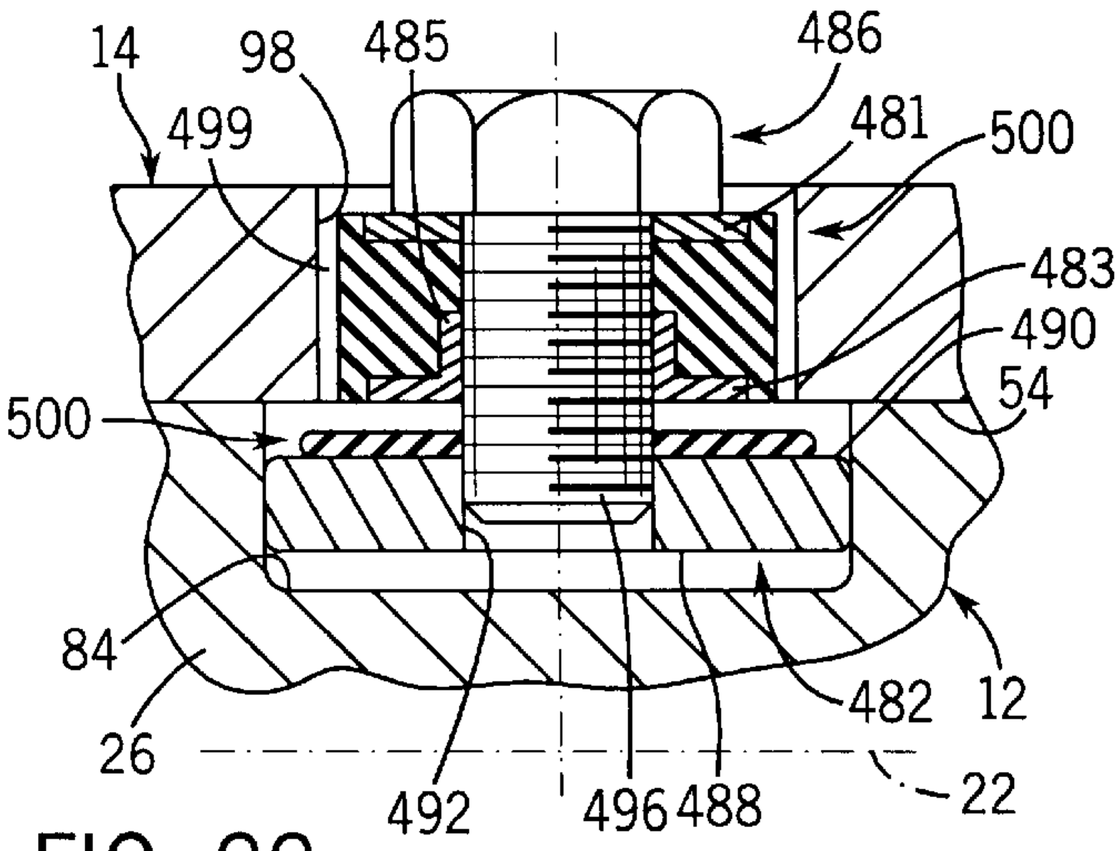


FIG. 21



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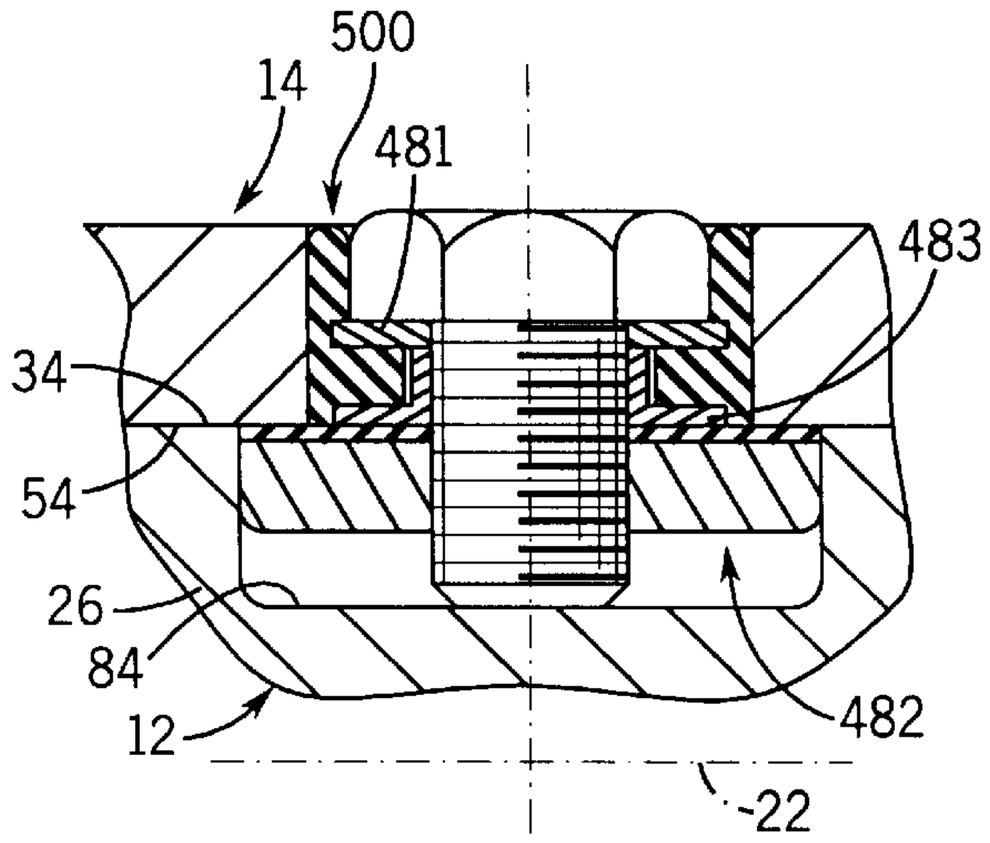

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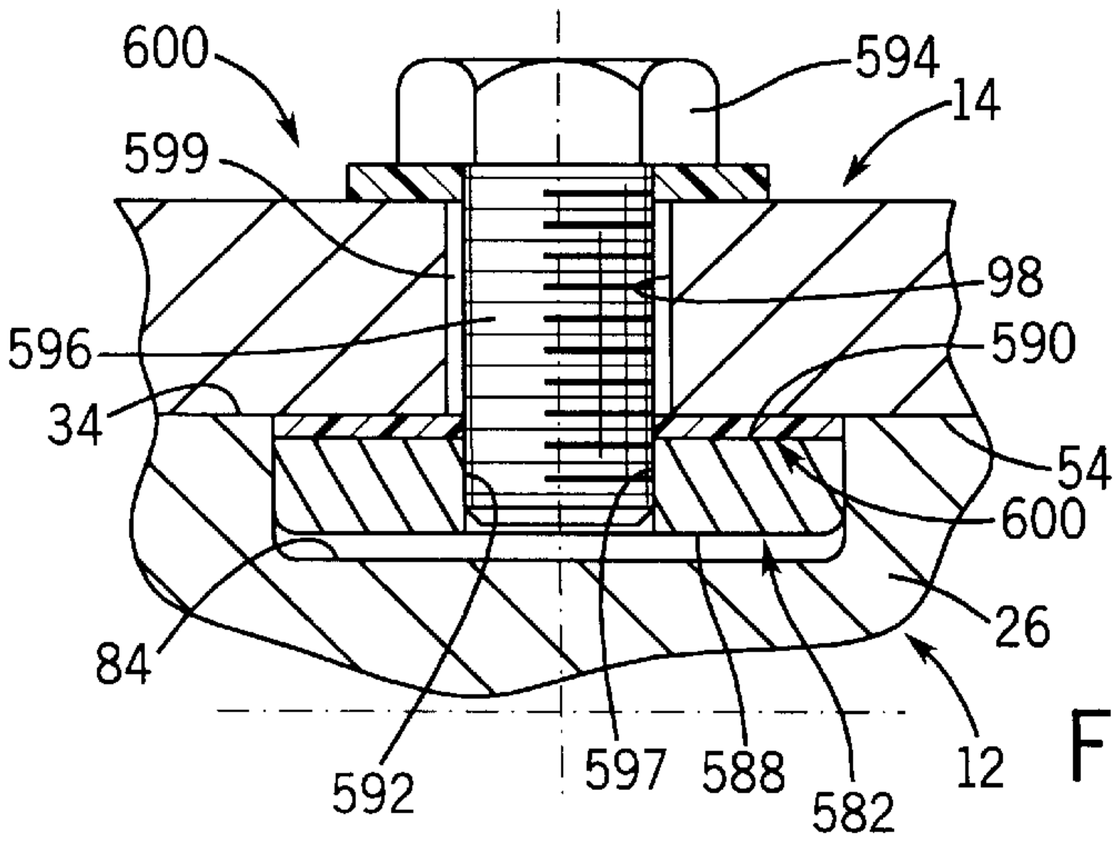

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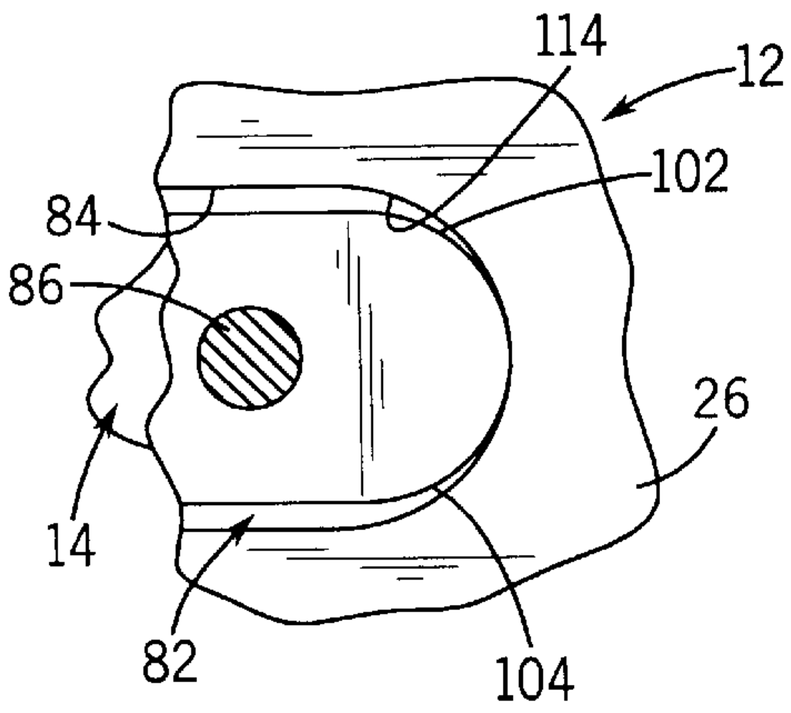
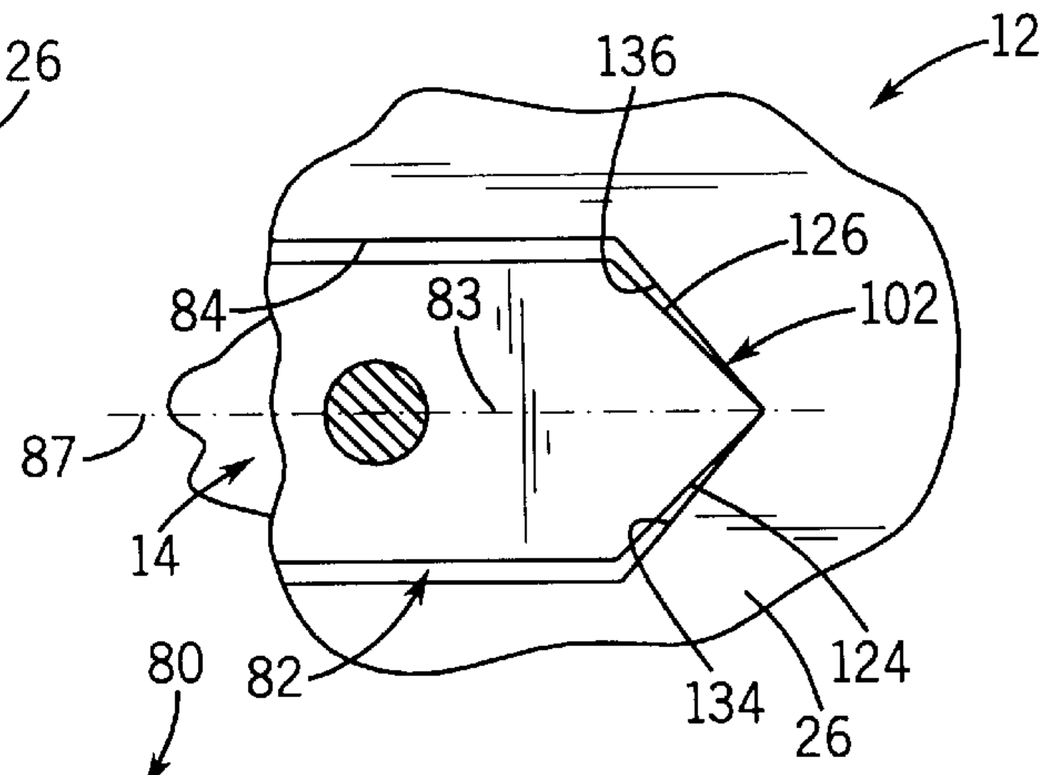


FIG. 25

FIG. 26



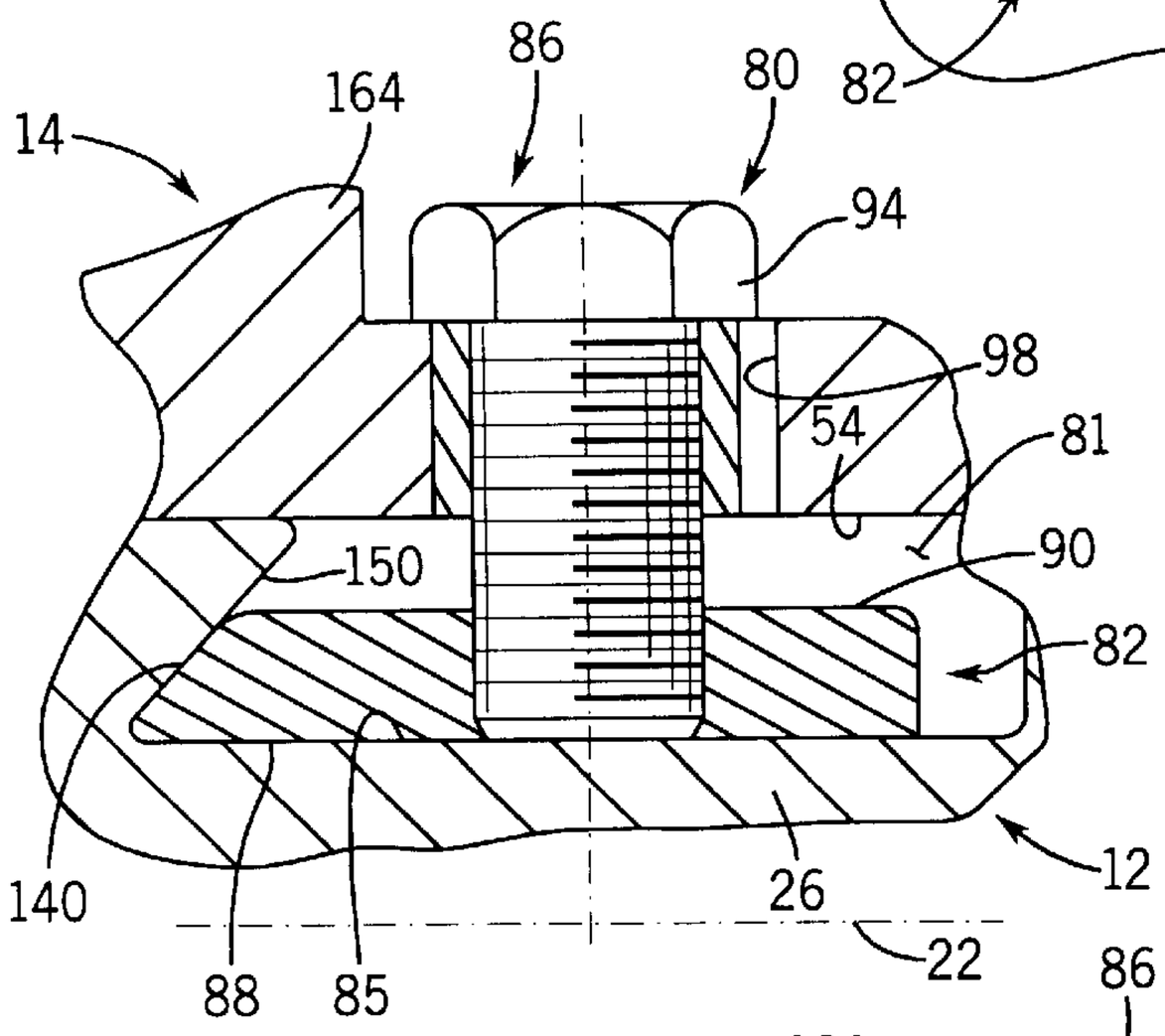


FIG. 27

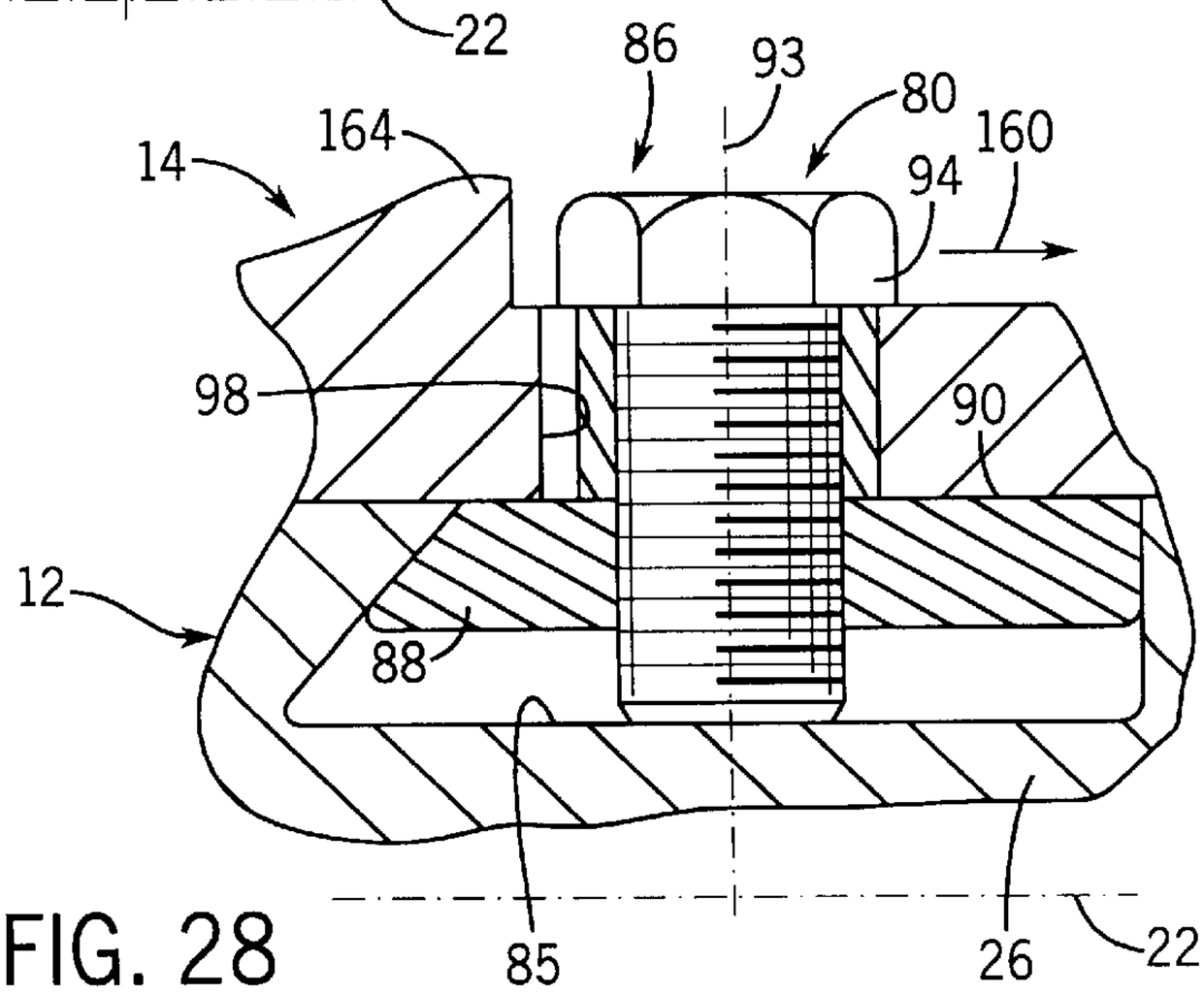


FIG. 28

HAMMERLESS ATTACHMENT ASSEMBLY FOR A TWO-PART DIGGING TOOTH SYSTEM

FIELD OF THE INVENTION

The present invention generally relates to a two-part digging tooth system and, more specifically, to a hammerless attachment assembly for releasably maintaining an adapter and a replacement part of a two-part tooth system in operable combination relative to each other.

BACKGROUND OF THE INVENTION

Excavating equipment used in mining, construction and a myriad of other ground engaging operations typically includes a series of spaced apart ground engaging tools or teeth arranged in side-by-side relation across a bucket lip or blade. The digging teeth project forwardly and serve to break up material to be gathered into a bucket of such excavating equipment.

The art recognized long ago the advantages to be gained by constructing each digging tooth as a two-part system. That is, the art recognized the advantages to be obtained by connecting a ground engaging tooth or tool to an adapter or support which, in turn, is connected to the bucket of excavating equipment. Typically, the adapter or support is provided with a base portion which is configured for attachment to the forward lip or blade of a bucket and a free ended nose portion. The digging tool is typically provided with a blind cavity or pocket whereby allowing the tool to fit over and along the adapter nose portion. As will be appreciated by those skilled in the art, the size of the adapter and digging tooth vary depending upon the particular digging application. For example, a two-part digging tooth system can vary in weight between a few pounds, i.e., three to five pounds, to two-hundred pounds.

During some digging operations, such teeth assemblies are subjected to highly abrasive conditions and, thus, experience considerable and rapid wear. Unless the conjuncture between the component parts of the two-part system is properly fitted, wear problems, especially in the pocket or cavity of the replacement part and along the nose portion of the adapter, can result. Moreover, the relatively high forces developed during some digging operations furthermore add to the rapid wear of the component parts of the digging tooth assembly.

In service, and although specific steps may be taken during fabrication of the digging teeth, a forward cutting edge of the replacement part sometimes quickly wears and become dull and, thus, inefficiencies in the digging operation develop thereby requiring replacement of such parts. As mentioned, the multipiece or two-part construction of such a tooth assembly advantageously allows the digging or excavating tooth to be replaced independent of the adapter. Depending upon conditions, a given adapter can be successfully equipped with anywhere from five to thirty replacement digging teeth to maintain sharp penetrating edges. In the field, replacement of worn excavating or digging teeth is a common and sometimes a daily experience.

It is well known in the industry to releasably interconnect the component parts of the two-component parts with an elongated retaining pin. Removing the replacement part from the digging system component parts, however, involves a tedious and often difficult task of pounding the retaining pin from registering apertures in the replacement part and the adapter. Removal of the retaining pin is typically effected by using a large hammer to manually and

endwise force the retaining pin from the apertures in the digging tooth and adapter. Of course, with larger two-part digging systems, the retaining pins are proportionately sized larger thereby adding to the manual effort and, thus, increasing the time and effort involved to effect digging tooth replacement and/or repair. Problems involving the hammer missing the punch or other tool used to removably pound the retaining pin and hitting the hand of the operator are well known. Of course, similar problems exist when the retaining pin is again pounded into the apertures to effect reattachment of the replaceable part and the adapter. The availability of appropriate tools, i.e., hammers and punches, is a consistent and well known problem.

Many two part digging systems arrange the retaining pin along a generally horizontal axis. As will be appreciated by those skilled in the art, with the digging systems being mounted in side-by-side relation relative to each other across the bucket lip, the horizontal disposition of the retainer pin for each digging system only adds to the time and effort required to initially remove the pin, whereby allowing for removal/repair of the worn/broken part of the digging system and, subsequently, reinsertion of the pin into the registered apertures in the replacement part and adapter of the two-part system. Some operators utilize specially designed tools to facilitate removal of the horizontal pins. Of course, availability of such tools is another problem.

It is also known to arrange the retaining pin in a generally vertical orientation. While advantageously enhancing access to the retaining pin, such retaining devices are more susceptible to the forces applied thereto as a result of the generally vertical movements of the bucket during a digging/excavating operation. Moreover, with a vertically oriented pin system, the lower hole or aperture in the replacement part of the two-part digging system is more exposed—as compared to a horizontal pinning system—to the ground surface over which the digging implement or bucket moves during a digging operation.

In any digging or excavating operation, contaminants including rocks, dust, dirt fines, moisture, and etc. furthermore exacerbate removal of the retaining pin. During any digging or excavating operation, small rocks, stones, dirt, dirt fines, and dust quickly accumulate, fill, and pack into holes or apertures in the digging tooth and adapter. As will be appreciated, moisture readily and quickly moves between confronting surfaces formed at the conjuncture of the digging tooth and adapter and passes toward the retaining pin. As is well known, the moisture corrodes and rusts on the surfaces of both the retainer pin and closed margins of the apertures in the digging tooth and adapter thereby adding to the problem of retaining pin removal. Moreover, such moisture often combines with the small rocks, stones, dirt, dirt fines, and dust already packed and filled into the apertures or holes of the component parts of the two-part tooth system, thereby adding to the considerable labor already involved with effecting tooth replacement.

Using threaded devices for releasably interconnecting component parts of a two-part tooth system have been previously proposed. For example, U.S. Pat. Nos. 5,337,495 and 6,052,927 to S. Pippins disclose an externally threaded tooth point bolt in combination with an insert for releasably maintaining a digging tooth and adapter in operable combination relative to each other. Like others before, the Pippins devices do not solve the problem of having contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture passing into the apertures and onto both internal and external threads of the interconnecting devices thereby resulting in clogging, oxidation and corrosion of the

mating surfaces. Of course, contamination of any mating threaded surfaces as by clogging, oxidation or rusting can only further add to the problems of disconnecting the related parts relative to each other when servicing of the worn part of the two-part system, is required. Moreover, the Pippins devices fail to disclose any means for inhibiting wear between the component parts of a two-part digging tooth system.

Thus, there is a desire and a continuing need for a hammerless attachment assembly for releasably maintaining component parts of a two-part digging tooth system in operable combination relative to each other. There is also a continuing need and desire for a two-part tooth system having an attachment assembly which enhances the conjuncture between the component parts of the system thereby reducing wear between the parts.

SUMMARY OF THE INVENTION

In view of the above, and in accordance with one aspect of the present invention, there is provided a hammerless attachment assembly for releasably maintaining component parts of a two-part digging tooth system in operable combination relative to each other. The component parts of the tooth system include an adapter having a nose portion with multiple sides and a ground engaging tool defining an open ended blind cavity or pocket for allowing the tool to fit over and along a length of the adapter nose portion.

The hammerless attachment assembly of the present invention includes an insert nonrotatably fitted within a recess defined on a side of the nose portion of the adapter and a rotatable fastener having a head portion and an externally threaded shank portion. A lengthwise portion of the fastener extends through an opening having a closed margin defined in a side of the tool, with the opening in the side of said tool registering with the internally threaded bore in said insert when the tool is positioned on the nose portion of the adapter. To releasably fasten the tool and adapter in operable combination relative to each other, the externally threaded shank portion of the fastener forms a threaded juncture with the internally threaded bore on the insert such that, in response to rotation of the fastener in a first direction, the insert is drawn toward and, ultimately, moved into clamping relation with an interior side surface of said blind cavity while remaining, at least partially, within the recess in the adapter thereby releasably maintaining the tool and adapter in operable combination relative to each other.

According to one aspect of the invention, elastomeric material is disposed in operable combination with the rotatable fastener and the insert for inhibiting contaminants from adversely effecting the threaded juncture between the fastener and the insert. As will be appreciated by those skilled in the art, inhibiting contaminants from adversely effecting the threaded juncture between the fastener and the insert will facilitate rotation of the fastener in a direction opposed to said first direction when the tool is to be released from operable combination with the adapter.

In one form, the elastomeric material extends along the entire lengthwise section of the externally threaded shank portion of the fastener extending through the insert. In another form, elastomeric material is configured as part of the insert and defines the internally threaded bore for the insert. In this form, the elastomeric material has an exterior configuration which inhibits separation of the elastomeric material from the insert as the insert is drawn toward and ultimately moved into clamping relation with the interior side surface of said blind cavity defined by the tool.

The insert preferably includes inner and outer surfaces. The insert's inner surface faces the adapter and the outer surface of the insert is arranged adjacent the interior side surface of the blind cavity after the fastener is rotated to draw the insert into clamping relationship therewith. Alternatively, the insert can embody a two-piece construction with a first piece or part defining the internally threaded bore and the second part or piece being arranged in operable engagement with the first part when the insert is inserted into the recess in the side surface of the adapter. According to still another aspect of the invention, the insert is formed from a non-ferrous material. Accordingly, moisture passing between the parts of the digging system will have limited, if any, adverse effect on the threaded juncture established between the insert and the threaded fastener.

In yet another embodiment, and in response to the insert being clamped against the interior surface of the tooth cavity, elastomeric material is squeezed between insert and the interior surface of the tooth cavity. In this form, elastomeric material furthermore extends, at least partially, into operable surrounding relation with the externally threaded shank portion of said fastener thereby inhibiting contaminants from getting through to the threaded juncture between the fastener and the insert. As such, the threaded juncture is sealed against contaminants interfering with proper and efficient operation between the fastener and insert of the retainer assembly.

As will be appreciated by those skilled in the art, the nose portion of the adapter and the blind cavity or pocket defined by the tool have complimentary cross-sections. In a preferred form, at least a top surface of the nose portion of the adapter is configured with two angled sides disposed on opposed lateral sides of a longitudinal centerline of the adapter. Similarly, the blind cavity defined by the tool opens to a rear end of the tool and includes a top surface having two angled sides disposed on opposed lateral sides of the longitudinal centerline of the tool and are complimentary relative to the angle sides on the top surface of the adapter.

The angled configuration of the sides on the nose portion of the adapter and tool cavity provide advantages over other cross-sectional configurations at the conjuncture between the tool and adapter. For example, the angled sides on the adapter and cavity advantageously provide a larger bearing surface at the conjuncture between the adapter and tool than is offered by horizontally configured surfaces. Of course, a larger bearing surface yields enhanced load distribution of the forces imparted to those surfaces. Moreover, the angled side configuration on the adapter and cavity advantageously provide a self-centering effect at the conjuncture between the tool and the adapter.

In this regard, both the insert accommodating recess in the side of the adapter and the insert are preferably configured to enhance the self-centering effect between the tool and the adapter on which it is mounted. More specifically, the recess defined in the side of the adapter and the insert are preferably configured with complimentary surfaces which cooperate relative to each other to enhance the self-centering effect at the conjuncture between the tool and adapter. Moreover, when the top surface of the adapter is configured with angled sides, the open top insert accommodating recess in the side of the adapter defines an axis extending generally normal to the side surface of the adapter to which the recess opens.

Another aspect of the present invention relates to the ability of the attachment assembly to enhance the conjuncture between the adapter and tool by urging to the tool onto the nose portion of the adapter in response to the fastener

being rotated in a direction to tighten the clamping relationship of the insert against the interior surface of the blind cavity defined by the tool. To effect such ends, the rotatable fastener of the attachment assembly includes a portion for engaging a closed margin of the opening in the side of the replacement part through which the fastener extends. Moreover, the insert and the insert accommodating recess on the nose portion of the adapter define confronting surfaces which cooperate relative to each other as the insert is drawn toward the interior surface of the cavity, in response to rotation of the fastener. The confronting surfaces cause the insert and, ultimately, the replacement part to move rearward in a direction extending generally parallel to the longitudinal axis of the adapter thereby enhancing the tightness of the conjuncture between the interior surfaces of the blind cavity and the nose portion of the adapter.

A primary object of the present invention is to provide an improved attachment assembly for releasably maintaining a replacement part and an adapter of a two-part digging system in operable combination relative to each other.

A further object of the present invention is to provide a hammerless attachment assembly for a two-part digging system including a replacement part and an adapter and which offers enhanced ease of repair/replacement of the replacement part, when required, during a digging operation.

Another object of the present invention involves providing a hammerless attachment assembly for a two-part digging system including a replacement part and an adapter and wherein the two-parts of the digging system are maintained in operable combination relative to each other through a fastener forming a threaded juncture with an insert arranged in a recess on the adapter and wherein elastomeric material inhibits contaminants, inherent with digging environments, from adversely effecting the threaded juncture thereby promoting release of the fastener from the insert, when required, and, thus, enhancing replacement of worn parts of the two-part digging system.

Still another object of the present invention is to provide a hammerless attachment assembly for releasably maintaining a replacement part and an adapter of a two-part digging system in operable combination relative to each other and wherein the attachment assembly includes a rotatable fastener which enhances the conjuncture between the replacement part and the adapter in response to rotation of the fastener in a direction to releasably fasten the replacement part to the adapter.

These and other numerous objects, aims, and advantages of the present invention will become readily apparent from the following detailed description, drawings, and appended claims.

DETAILED DESCRIPTION OF THE DRAWINGS

FIG. **1** is a top plan view of one form of two-part digging system embodying features of the present invention;

FIG. **2** is a side elevational view of the two-part digging system shown in FIG. **1**;

FIG. **3** is a perspective view of the two-part digging system illustrated in FIG. **1**;

FIG. **4** is a top plan view of one form of adapter to which principals of the present invention would apply;

FIG. **5** is a side elevational view of the adapter illustrated in FIG. **4**;

FIG. **6** is a perspective view of the adapter illustrated in FIG. **4**;

FIG. **7** is a top plan view of one form of replacement part or tool forming part of the two-part digging system to which principals of the present invention apply;

FIG. **8** is a side elevational view of the replacement part illustrated in FIG. **7**;

FIG. **9** is a rear end view of the replacement part illustrated in FIG. **7**;

FIG. **10** is a sectional view taken along line **10—10** of FIG. **1**;

FIG. **11** is a perspective view of one form of insert forming part of the attachment assembly of the present invention;

FIG. **12** is a top plan view of the insert illustrated in FIG. **11**;

FIG. **13** is a side elevational view of the insert illustrated in FIG. **11**;

FIG. **14** is an enlarged view taken along line **14—14** of FIG. **1**;

FIG. **15** is a view similar to FIG. **14** but showing the insert arranged in clamping relation relative to an interior surface of a blind cavity defined by the tool or replaceable part of the two-part digging system;

FIG. **16** is an enlarged, partially sectioned, view similar to FIGS. **14** and **15** but showing another alternative form of insert forming part of the attachment assembly of the present invention;

FIG. **17** is an enlarged view of still another alternative form of insert forming part of the attachment assembly of the present invention;

FIG. **18** is an enlarged view of yet another form of insert forming part of the attachment assembly of the present invention;

FIG. **19** is a view similar to FIG. **18** but showing the insert arranged in clamping relation relative to an interior surface of a blind cavity defined by the tool or replaceable part;

FIG. **20** is an enlarged view of another form of insert forming part of the attachment assembly of the present invention;

FIG. **21** is a view similar to FIG. **20** but showing the insert arranged in clamping relation relative to an interior surface of a blind cavity defined by the tool or replaceable part;

FIG. **22** is an enlarged view of still another form of insert forming part of the attachment assembly of the present invention;

FIG. **23** is a view similar to FIG. **22** but showing the insert arranged in clamping relation relative to an interior surface of a blind cavity defined by the tool or replaceable part;

FIG. **24** is an enlarged, partially sectioned, view of yet another form of insert forming part of the attachment assembly of the present invention;

FIG. **25** is an enlarged plan view of another configuration for one end of the insert and the recess in the adapter which accommodates the insert;

FIG. **26** is an enlarged plan view of another configuration for one end of the insert and the recess in the adapter which accommodates the insert;

FIG. **27** is enlarged, partially sectioned, view showing cooperating surfaces on the insert and the adapter for advantageously enhancing the conjuncture between the adapter and replacement part of the two-part digging system in response to the attachment assembly of the present invention being utilized to maintain the adapter and tool or replacement part of the two-part digging system in operable combination relative to each other; and

FIG. **28** is a view similar to FIG. **27** but showing the insert of the attachment assembly in clamping relation relative to

an interior surface of a blind cavity defined by the replacement part or tool of the two-part digging system.

Detailed Description of the Present Invention

While the present invention is susceptible of embodiment in multiple forms, there are shown in the drawings and will hereinafter be described various preferred embodiments of the present invention with the understanding the present disclosure is to be considered as setting forth exemplifications of the invention which are not intended to limit the invention to the specific embodiments illustrated and described.

Referring now to the drawings, wherein like reference numerals indicate like parts throughout the several views, there is shown in FIG. **1** a two-part digging system **10** including a support **12** and a replaceable part **14**. In the illustrated embodiment, the replaceable part **14** of the digging system **10** is shown as a digging tooth. It should be appreciated, however, the replaceable part **14** can take a myriad of different designs other than a tooth, i.e., a ripper, etc.

Although only a single ground engaging tooth assembly **10** is shown in FIG. **1** attached to excavating equipment **16**, such as a forward lip **18** of an excavating bucket or the like **20**, it will be understood to those skilled in the art that on a typical piece of excavating or digging equipment, a plurality of two-part digging systems, substantially identical to that illustrated in FIG. **1**, extend forwardly from the bucket lip or blade **18** in a ground engaging orientation. Moreover, it should be appreciated that the bucket or shovel **20** to which the two-part system **10** is attached moves both vertically and horizontally during a digging operation.

As schematically illustrated in FIGS. **1** through **4**, the adapter or support **12** has an elongated free ended configuration defining a longitudinal centerline **22**. The adapter or support **12** includes a conventional base portion **24** and axially aligned and elongated nose portion **26** extending forwardly from the base portion **24**. The base portion **24** is configured for suitable attachment to the ground engaging apparatus or bucket **20**. As is conventional, the replaceable part or tooth **14** fits endwise along and about the nose portion **26** of the adapter **12**. In a preferred embodiment, the adapter **12** is formed as a result of a forging operation thereby adding strength and rigidity to the adapter **12**.

Although a specifically configured nose portion **26** for the adapter **12** is illustrated in the drawings and will hereinafter be described, it should be appreciated the principals of the present invention equally apply to adapters which are configured other than that illustrated in the drawings and hereinafter described. In the preferred form, the nose portion **26** of the adapter **12** has a forwardly tapering configuration including angularly converging top and bottom exterior surfaces **30** and **40**, respectively. In the illustrated embodiment, the top and bottom surfaces **30** and **40**, respectively, are disposed to opposed vertical sides of the longitudinal centerline **22** of the adapter **12**. In a most preferred embodiment, the top and bottom exterior surfaces **30**, **40**, respectively, are each provided with stabilizing lands **32** and **42** preferably arranged at the foremost end of the adapter **12**.

In the embodiment illustrated for exemplary purposes, the conjuncture between the adapter **12** and replaceable part **14** has been configured to provide and effect advantageous results during operation of the two-part digging system **10**. More specifically, the adapter **12** and replaceable part **14** are configured to enhance the surface area contact at the conjuncture between the adapter **12** and replaceable part **14**. Moreover, the conjuncture between the adapter **12** and replaceable tool **14** is preferably configured to promote a self-centering effect of the replaceable part **14** on and along the nose portion **26** of the adapter **12**.

As shown in FIGS. **4** and **6**, the exterior top surface **30** of the adapter nose portion **26** is preferably provided with two angled sides **34** and **36** arranged on opposite lateral sides of the longitudinal centerline **22** of the adapter **12**. Each side **34**, **36** of top surface **30** preferably has a generally planar configuration extending downwardly at an angle ranging between about 30° and about 70° relative to a horizontal plane. In a preferred embodiment, each side **34**, **36** of the top surface **30** angles downwardly at an angle of about 50° relative to a horizontal plane. Moreover, the angled sides **34**, **36** are preferably joined to each other along a common top edge **35** extending forwardly from a rear portion and for a major length of the adapter **12**. In a most preferred form, the common top edge **35** has a radiused configuration.

In the illustrated embodiment, the exterior bottom surface **40** of the adapter **12** is provided with two angled sides **44** and **46** arranged on opposite lateral sides of the longitudinal centerline **22** of the adapter **12**. The sides **44**, **46** are preferably planar in configuration. When considered with the angled sides **34**, **36** of the exterior top surface **30**, the upwardly angled sides **44**, **46** of the bottom surface **40** preferably provide a major lengthwise section of the nose portion **26** of the adapter **12** with a rhombus-like or quadrilateral configuration. The angled sides **44**, **46** of the exterior bottom surface **40** of the adapter **12** are preferably joined to each other along a common bottom edge **45** extending forwardly and for a major lengthwise portion of the adapter **12**. In a most preferred form, the common bottom edge **45** has a radiused configuration.

In the embodiment of the invention illustrated for exemplary purposes, the angled sides **34**, **44** disposed to a common lateral side of the longitudinal axis of the adapter **12** are preferably joined to each other along a common side edge **39** extending longitudinally forward from the base portion **24** for a major length of the nose portion **26** of the adapter **12**. The common side edge **39** is formed at the intersection of those planes defined by and along the planar configuration of the sides **34**, **44**. Preferably, the common side edge **39** has a radiused configuration.

Similarly, the angled sides **36**, **46** disposed to a common lateral side of the longitudinal axis **22** of the adapter **12** are preferably joined to each other along a common side edge **49** extending longitudinally forward from the base portion **24** and for a major length of the nose portion **26** of the adapter **12**. The common side edge **49** is formed at the intersection of those planes defined by and along the planar configuration of the sides **36**, **46**. Preferably, the side edge **49** has a radiused configuration.

The replacement part or digging tooth **14** of the two-part digging system **10** generally has an elongated wedge shape with a longitudinal centerline **52** and is configured to fit lengthwise along and about the nose portion **26** of the adapter **12** (FIG. **4**). To effect such ends, and as illustrated in FIGS. **7** through **9**, a rear portion of the replacement part or tool **14** is configured with multiple sides which combine to define an open ended blind cavity **54** therebetween. Suffice it to say, the multiple exterior sides of the replacement part can take on a myriad of different shapes as long as the cross-sectional configuration of the cavity or pocket **54** closely proximates the cross-sectional configuration of the nose portion **26** of the adapter **12** and whereby the conjunc-

ture between the adapter **12** and the replacement part or tool **14** minimizes movement between component parts of the two-part digging system **10** after the component parts **12, 14** are arranged in operable combination relative to each other. To add strength and rigidity thereto, part **14** is preferably formed from a forging operation.

The open ended blind cavity or pocket **54** includes top and bottom interior surfaces **60** and **70**, respectively, extending forwardly from the open rear end of the cavity **54**. As will be appreciated, the top and bottom interior surfaces **60, 70** angularly converge toward each other at substantially the same angles as the top and bottom exterior surfaces **30, 40**, respectively, of the adapter nose portion **24**. The top and bottom interior surfaces **60, 70**, respectively, terminate in an end wall **56** defined by cavity **54**.

As shown, the top and bottom interior surfaces **60** and **70**, respectively, of cavity **54** are disposed to opposed vertical sides of the longitudinal centerline **52** of part **14**. In a most preferred embodiment, the top and bottom surfaces **60** and **70**, respectively, each include stabilizing lands **62** and **72**, respectively, extending rearwardly from the end wall **56**. Preferably, the stabilizing lands **62, 72** on part **14** cooperate and mate with the stabilizing lands **32, 42** on the adapter **12** after the component parts **12, 14** are arranged in operable combination relative to each other to facilitate transfer of forces applied to the assembly **10** to the excavating equipment **16**.

The blind cavity or pocket **54** defined by part **14** preferably has a rhombus-like or quadrilateral cross-sectional configuration. In the preferred embodiment, the interior top surface **60** includes two angled sides **64** and **66** arranged on opposite lateral sides of the longitudinal centerline **52** of part **14**. Preferably, each side **64, 66** of cavity **54** has a generally planar configuration extending downwardly at an angle generally corresponding to the angle of the confronting surface **34, 36** on the exterior top surface **30** of the adapter nose portion **26**. Moreover, the sides **64, 66** of top surface **60** are preferably joined to each other along a common top edge **65** extending forwardly from the open end **58** and for a major length of the cavity **54**. In a most preferred form, the common top edge **65** has a radiused configuration.

In the embodiment illustrated, the interior bottom surface **70** of cavity **54** is provided with two upwardly angled sides **74** and **76** arranged on opposite lateral sides of the longitudinal centerline **52** of part **14**. The sides **74, 76** are preferably planar in configuration and are preferably joined to each other along a common bottom edge **75** extending forwardly from the open end and for a major length of the cavity **54**. In a most preferred form, the common bottom edge **75** has a radiused configuration.

Preferably, the angled sides **64, 74** of the cavity **54** which are disposed to a common lateral side of the longitudinal axis **52** of part **14** are joined to each other along a common side edge **69** extending longitudinally forward from the open end and for a major length of the cavity **54**. The common side edge **69** is formed at the intersection of those planes defined by and along the planar configuration of the sides **64, 74**. The common side edge **69** preferably has a radiused configuration.

Similarly, the angled sides **66, 76** of the cavity **54** disposed to a common lateral side of the longitudinal axis **52** of part **14** are preferably joined to each other along a common side edge **79** extending longitudinally forward from the open end and for a major length of the cavity **54**. The common side edge **79** is formed at the intersection of those planes defined by and along the planar configuration of the sides **66, 76**. Preferably, the side edge **79** has a radiused configuration.

In accordance with the present invention, a hammerless attachment assembly **80** maintains the adapter **12** and replaceable part or tool **14** in operable combination relative to each other. As schematically illustrated in FIG. **10**, the hammerless attachment assembly **80** includes an insert or first part **82** nonrotatably fitted or accommodated within a recess or cavity **84** defined by the adapter **12** and a rotatable threaded fastener or second part **86**. The first and second parts **82** and **86**, respectively, combine with each other, through an operative or threaded juncture **87**, to selectively maintain the component parts **12** and **14** in operable combination relative to each other.

Broadly stated, one of the salient features of the present invention involves providing elastomeric material in operable combination with the insert or first part **82** and the threaded fastener or second part **86** of the attachment assembly **80** whereby inhibiting contaminants from getting through to or adversely effecting the operative or threaded juncture between the component parts **82, 86** of the attachment assembly **80** after the adapter **12** and replacement part or tool **14** of the two-part digging system **10** are arranged in operable combination relative to each other. As used herein and throughout, the term "elastomeric material" means and refers to: natural rubber, synthetic rubber, plastic, polyvinyl, polymide materials, nylon, composites, polyethylene, ultra-high molecular weight materials, and any of numerous organic, synthetic, or processed materials or substances which are strong and, to a limited degree, compressible. Preferably, such elastomeric materials have a Shore A hardness ranging between about **50** and about **80**.

As schematically illustrated in FIGS. **4** through **6** and **10**, recess **84** has an open top configuration and is preferably defined toward the rear on side **36** of the exterior top surface **30** of adapter **12**. In the example illustrated in FIG. **10**, the recess **84** is preferably disposed about middistance between the common top edge **35** and the common side edge **39** defined by the adapter nose portion **26**. In the example illustrated in FIG. **10**, recess **84** defines an axis **85** extending generally normal or perpendicular to the planar side **34** of the adapter nose portion **26**.

As will be appreciated from an understanding of the present invention, the recess or cavity **84** is configured to removably receive, accommodate and prevent the insert **82** from rotating or turning in a plane parallel to the side **34** of the adapter **12** after the threaded fastener or second part **86** threadably engages with the insert **82** to removably secure the parts **12** and **14** of assembly **10** in operable combination relative to each other. In the illustrated embodiment, recess **84** has a generally rectangular configuration. It should be understood, however, various shapes can be used for the recess **84**, such as square, triangular, star-shaped and the like, so long as insert **82** has a complimentary shape and such that rotation of the insert **82** in a plane parallel to the exterior side of the adapter **12** defining the recess **84** is prevented after the insert **82** is inserted thereinto.

Of course, and as will be furthermore appreciated, the recess **84** could readily be located on side **34** of the top surface **30** of the nose portion **26** of adapter **12** without detracting or departing from the spirit and scope of the present invention. Albeit preferable with the illustrated embodiment of the two-part digging system to locate the recess **84** on either side **34, 36** of the top surface **30** of the adapter **12**, it is, of course, possible to alternatively locate the recess **84** on either side **44, 46** of the bottom surface **40** of the nose portion **26** of the adapter **12** without departing or detracting from the spirit and scope of the present invention.

As illustrated in FIGS. **10, 11** and **13**, insert **82** has inner and outer surfaces **88** and **90**, respectively. The inner surface

88 of insert 82 is disposed adjacent to and in confronting relation with a bottom surface 85 of the recess or cavity 84 after the insert 82 is initially inserted within the recess 84. The outer surface 90 of insert 82 is disposed a further radial distance from the axis 22 of the adapter 22 than is inner surface 88. In the illustrated embodiment, the surfaces 88 and 90 of insert 82 are arranged in generally parallel relation relative to each other. An internally threaded bore or throughopening 92 is generally centrally defined by the insert 82. As shown, the bore or threaded opening 92 defines an axis 93 extending generally normal or perpendicular to at least one surface 88, 90 defined by the insert 82.

In the embodiment illustrated in FIG. 10, the second part or threaded fastener 86 includes first and second portion 94 and 96, respectively. The first and second portions 94 and 96 of the fastener 86 are preferably axially aligned relative to each other along an axis 95 of the fastener 86. The first portion 94 of fastener 86 is preferably configured as a head portion which is removably engagable by a conventional tool to effect rotation of the fastener 86 in either first or second directions about the axis 95. The second or shank portion 96 of fastener 86 has an externally threaded configuration and forms the threaded juncture 87 when the second or shank portion 96 of fastener 86 threadably engages with the internally threaded bore 92 of the first part or insert 82 of the hammerless attachment assembly 80.

As illustrated in FIGS. 10, 14 and 15, the second or threaded shank portion 96 of fastener 86 is sized to extend lengthwise through a preferably closed marginal bore, throughopening, or elongated slot 98 defined in that side of the digging tool or replaceable tooth 14 which is complimentary to that exterior side of the adapter nose portion 26 defining the recess 84. Notably, the bore, throughopening, or elongated slot 98 of the replaceable part 14 is sized such that the first or head portion 94 of the fastener 86 is inhibited from passing into the opening 98 even though and after the externally threaded shank portion 96 of fastener 86 and the internally threaded bore 92 on insert 82 establish and maintain a threaded juncture therebetween. As shown, and to facilitate assembly, the closed margin of the bore, throughopening, or elongated slot 98 has an inside diameter which is slightly larger than the outside diameter on the second or shank portion 96 of the fastener 86 whereby an opening or gap 99 is defined therebetween.

In that form illustrated in FIGS. 11 through 15, elastomeric material 100 is provided, at least, between the outer surface 90 of insert 82 and the confronting interior surface of the tooth cavity or pocket 54 toward and against which the insert 82 is drawn in response to rotation of the fastener 86 in the first direction. As will be appreciated, in response to rotation of the fastener 86 in a first direction, insert 82 is drawn toward and, ultimately, is moved into tightly clamped relation with the confronting interior surface of the tooth cavity or pocket 54 while remaining, at least partially, within the insert accommodating recess or cavity 84 thereby releasably maintaining the adapter 12 and replaceable tooth 14 in operable combination relative to each other.

As the insert 82 is drawn into clamping relationship with the confronting interior surface of the tooth cavity 54, elastomeric material 100 is squeezed and flows into the opening 99 around the fastener shank portion 96 and the closed margin of the tooth aperture, bore or opening 98 through which the fastener shank portion 96 extends. Likewise, the squeezed elastomeric material 100 tends to flow and fill tolerance variations or voids separating that area on the adapter angled side 34 immediately surrounding the recess 84 and the confronting interior surface of the tooth pocket or cavity 54. As such, contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from passing between the conjoined surfaces of parts 12 and 14 and reaching the threaded juncture 87 between the insert 82 and the threaded fastener 86.

With the present invention, the elastomeric material 100 inhibits contaminants from adversely effecting the threaded juncture 87 between parts 82 and 86 of assembly 80. Accordingly, rotation of the fastener 86, in a direction opposed to the first direction, is facilitated when part 14 is to be released from the adapter 14. As will be appreciated by those skilled in the art, the ability to maintain the threaded juncture 87 substantially removed from contaminants significantly reduces the likelihood of clogging, oxidation or rusting of the mating surfaces between the externally threaded shank portion 96 of fastener 86 and the internally threaded bore 92 of the insert 82. Eliminating or reducing clogging, oxidation or rusting of the mating surfaces between the externally threaded shank portion 96 of fastener 86 and the internally threaded bore 92 of the insert 82 naturally tends to facilitate rotation of the fastener 86 in a direction to effect release of the hammerless attachment assembly 80 thereby readily allowing repair and/or replacement of part 14 of the two-part digging system 10.

FIG. 16 illustrates an alternative form for the insert of the hammerless attachment assembly of the present invention. This alternative form of insert is designated generally by reference numeral 182. The elements of this alternative hammerless attachment system that are functionally analogous to those components discussed above regarding attachment assembly 80 are designated by reference numerals identical to those listed above with the exception this embodiment uses reference numerals in the 100 series.

In the form illustrated in FIG. 16, elastomeric material 200 is configured as part of the insert 182 and defines the internally threaded bore 192 of the insert 182. Notably, the exterior configuration of the insert 200 is such that the elastomeric material 200 is prevented from separating from the remainder of the insert 182 as the insert 182 is drawn toward and, ultimately, moved into clamping relation relative with an interior surface of the pocket or cavity 54 of the replaceable tooth 14. In the illustrated embodiment, the exterior configuration of the elastomeric material 200 and the mating part of the insert 182 have mating frusto-conical configurations with the larger end thereof being disposed toward the inner surface 188 of the insert 182.

With this form of the invention, the elastomeric material 200 extends along at least the entire lengthwise section of the externally threaded shank portion 196 of the fastener 186 extending through the insert 182. As such, the elastomeric material 200 protects the entire lengthwise section of the externally threaded shank portion 196 of the fastener 186 extending through the insert 182 against clogging, oxidation or rusting of the mating surfaces between the externally threaded shank portion 196 of fastener 186 and the internally threaded bore 192 of the insert 182. Thus, this design naturally tends to facilitate rotation of the fastener 186 in a direction to effect release of the hammerless attachment assembly 180 thereby readily allowing repair and/or replacement of part 14 of the two-part digging system 10.

That embodiment of the invention illustrated in FIG. 17 is substantially similar to that illustrated in FIG. 16 but shows a slightly different exterior configuration for the elastomeric material 200'. Suffice it to say, in this form, the elastomer 200' is configured to prevent separation of the elastomer 200' from the remainder of the insert 182 when the fastener 186

is rotated in a direction to draw the insert **182** into tight clamping relation with the interior surface of the tool cavity **54**. Like that discussed above, the elastomeric material **200'** extends along at least the entire lengthwise section of the externally threaded shank portion **196** of the fastener **186** extending through the insert **182**. As such, the elastomeric material **200'** protects the entire lengthwise section of the externally threaded shank portion **196** of the fastener **186** extending through the insert **182** against clogging, oxidation or rusting of the mating surfaces between the externally threaded shank portion **196** of fastener **186** and the internally threaded bore **192** of the insert **182**. Thus, this design naturally tends to facilitate rotation of the fastener **186** in a direction to effect release of the hammerless attachment assembly **180** thereby readily allowing repair and/or replacement of part **14** of the two-part digging system **10**.

In yet another form, the insert for the hammerless attachment assembly of the present invention can be fabricated from a nonferrous metal material which is corrosion resistant such as copper, brass or any of several other nonferrous metal materials. Because the insert of the attachment assembly is corrosion resistant, rotation of the fastener in a direction to effect release of the attachment assembly, thus, enabling repair/replacement of the tool **14** will be facilitated. Because of the significant loads and forces expected to be exerted and which are placed onto the attachment assembly during operation of the two-part digging system **10**, however, use of a nonferrous metal insert as part of the hammerless attachment assembly could have limited application to smaller size two-part digging systems.

FIGS. **18** and **19** illustrate an alternative form for the insert of the hammerless attachment assembly of the present invention. This alternative form of insert is designated generally by reference numeral **282**. The elements of this alternative hammerless attachment assembly that are functionally analogous to those components discussed above regarding attachment assembly **80** are designated by reference numerals identical to those listed above with the exception this embodiment uses reference numerals in the 200 series.

In the form illustrated in FIG. **18**, the insert **282** comprises two metal pieces or parts **281** and **283**. Piece **281** of insert **282** defines the internally threaded bore or opening **292** for the insert **282**. The exterior configuration of insert **282** is sized to fit within the recess or cavity **84** on the side of the adapter **12**. Moreover, piece **283** of insert **282** defines inner and outer surfaces **288** and **290**, respectively, which, in the exemplary embodiment, extend generally parallel relative to each other. As shown, piece **281** also defines inner and outer surfaces **288'** and **290'**, respectively. The inner and outer surfaces **288'** and **290'** of piece **281** are separated by a lesser distance than are corresponding surfaces on piece **283**. Accordingly, when the pieces **281** and **283** of insert **282** are initially assembly within the recess **84**, an opening or void **289** exists between parts **281** and **283**.

As shown, the pieces **281** and **283** of insert **282** are configured such that piece **281** is prevented from separating from piece **283** as piece **281** is drawn toward the outer surface **290** of the insert **282** in response to rotation of the threaded fastener **286** to, ultimately, clamp the insert **282** against the interior surface of cavity **54** of the tool **14**, as shown in FIG. **19**, whereby releasably maintaining the adapter **12** and tool **14** in operable combination relative to each other. In the exemplary embodiment, pieces **281** and **283** of insert **282** define frusto-conical surfaces **285** and **287**, respectively. The frusto-conical surfaces **285** and **287** of pieces **281** and **283**, respectively, are sized relative to each other to define an opening or gap **291** therebetween.

In the embodiment illustrated in FIGS. **18** and **19**, and upon initial assembly of insert **282**, elastomeric material **300** is provided, at least, in the opening or gap **289** between the parts **281**, **283** and the inner interior surface of the cavity or pocket **54** against which the insert **282** is to be, ultimately clamped. Preferably, additional elastomeric material **300** is arranged between the sides of the insert **282** and the cavity or recess **84** in the adapter **12**.

As will be appreciated, in response to rotation of the fastener **286**, piece **281** is drawn toward the interior surface of the tooth pocket or cavity **54**. As piece **281** is drawn toward the interior surface of the tooth pocket or cavity **54**, the elastomeric material **300** is squeezed and flows into the opening **291** between the parts **281**, **283** and into the opening **299** around the second or shank portion **296** of fastener **286** and the closed margin of the aperture, bore or hole **98** in the replaceable tool **14** through which the second or shank portion **296** of the fastener **286** extends. Likewise, the squeezed elastomeric material **300** tends to flow and fill a tolerance variations or voids separating that area on the adapter angled side **34** immediately surrounding the recess **84** and the confronting interior surface of the tooth pocket or cavity **54**. As such, contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from passing between the confronting surfaces of parts **12** and **14** and reaching the threaded juncture **287** between parts **282** and **286**. Ultimately, rotation of the fastener **286** causes the insert **282** to be drawn and tightly clamped against the interior surface of the tooth cavity or pocket **54** while at least a portion of the insert **282** remains within the recess or cavity **84** thereby maintaining the adapter **12** and tooth **14** in operable combination relative to each other.

In the embodiment illustrated in FIGS. **18** and **19**, the bore **98** in part **14** is preferably configured as a counterbore. As such, a major portion or section of the first or head portion **294** of the fastener **286** is removed and protected from the exterior surface of the tool or replacement part thereby protecting the first or head portion **294** of the fastener **286** during operation of the two-part digging system **10**.

FIGS. **20** and **21** illustrate still another form for the insert of the hammerless attachment assembly of the present invention. This alternative form of insert is designated generally by reference numeral **382**. The elements of this alternative hammerless attachment assembly that are functionally analogous to those components discussed above regarding attachment assembly **80** are designated by reference numerals identical to those listed above with the exception this embodiment uses reference numerals in the 300 series.

In the form illustrated in FIG. **20**, the insert **382** comprises two metal pieces or parts **381** and **383**. Piece **381** of insert **382** defines the internally threaded bore or opening **392** for the insert **382**. The exterior configuration of piece **382** is sized to fit within the recess or cavity **84** on the side of the adapter **12**. Moreover, piece **383** of insert **382** preferably defines inner and outer surfaces **388** and **390**, respectively, which extend generally parallel relative to each other. In the embodiment illustrated, piece **381** also defines inner and outer surfaces **388'** and **390'**, respectively. The inner and outer surfaces **388'** and **390'** of piece **381** are separated by a lesser distance than are corresponding surfaces on piece **383**. Accordingly, when pieces **381** and **383** of insert **382** are initially assembly within the insert accommodating recess **84**, an opening, gap or void **389** is provided between the parts **381** and **383**.

As shown, the pieces **381** and **383** of insert **382** are configured such that piece **381** is prevented from separating

from piece **383** as piece **381** is drawn toward the outer surface **390** of the insert **382** in response to rotation of the threaded fastener **386** to, ultimately, clamp the insert **382** against the interior surface of cavity **54** of the tool **14**, as shown in FIG. **21**, whereby releasably maintaining the adapter **12** and tool **14** in operable combination relative to each other. In this embodiment, piece **383** of insert **382** defines a generally centralized counterbore or seat **385** which is sized to accommodate piece **381** of the insert **382** therewithin.

In the embodiment illustrated in FIGS. **20** and **21**, the fastener **386** of the hammerless attachment further includes a sleeve **387** which fits about and along the second or threaded portion **396** of fastener **386**. As shown, the outside diameter of the sleeve **387** is slightly less than the inside diameter of the bore or hole **98** in the replaceable part **14** through which the second portion **396** of the fastener **386** extends thereby allowing the fastener **386** and insert **382** to form the threaded juncture therebetween. The size difference between the sleeve **387** and the opening **92** defines a gap, opening or void **399** therebetween.

As shown in FIGS. **20** and **21**, elastomeric material **400** is provided, at least, in the opening, gap or void **389** provided between the parts **381**, **383**. Preferably, additional elastomeric material **400** is also be arranged between the sides of the insert **382** and the cavity or recess **84** in the adapter **12**.

As will be appreciated, in response to rotation of the fastener **386**, piece **381** is drawn toward the interior surface of the tooth pocket or cavity **54**. As piece **381** is drawn toward the interior surface of the tooth pocket or cavity **54**, the elastomeric material **400** is squeezed and flows from between the parts **381**, **383** and preferably into the opening **399** around the annular sleeve **397** of fastener **386** and the closed margin of the aperture, bore or hole **398** in the replaceable tool **14**. Likewise, the squeezed elastomeric material **400** tends to flow and fill a tolerance variations or voids separating that area on the adapter angled side **34** immediately surrounding the recess **84** and the confronting interior surface of the tooth pocket or cavity **54**. As such, contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from passing between the confronting surfaces of parts **12** and **14** and reaching the threaded juncture **397** between parts **382** and **386**. Ultimately, rotation of the fastener **386** causes the multiple part insert **382** to be tightly clamped against the interior surface of the tooth cavity or pocket **54** while at least a portion of the insert **382** remains within the recess or cavity **84** thereby maintaining the adapter **12** and tooth **14** in operable combination relative to each other.

FIGS. **22** and **23** illustrate yet another form for the insert of the hammerless attachment assembly of the present invention. This alternative form of insert is designated generally by reference numeral **482**. The elements of this alternative hammerless attachment assembly that are functionally analogous to those components discussed above regarding attachment assembly **80** are designated by reference numerals identical to those listed above with the exception this embodiment uses reference numerals in the 400 series.

In the form illustrated in FIGS. **22** and **23**, the insert **482** and is sized to fit within the recess or cavity **84** on the side of the adapter **12** and defines a generally centrally disposed, internally threaded bore or opening **492**. Insert **492** includes inner and outer surfaces **488** and **490**, respectively, which preferably extend generally parallel relative to each other.

As shown in FIGS. **20** and **21**, elastomeric material **500** is provided, at least, within the opening **98** in the tooth **14** in surrounding relation to and with a lengthwise portion of the fastener threaded shank portion **496** and the closed margin of the tooth aperture or hole **98**. Preferably, additional elastomeric material **500** is arranged between the outer side or surface **490** of the insert **482** and the interior surface of the tooth cavity or pocket **54** against which the insert **482** is, ultimately, to be clamped.

In this embodiment, a metal washer or piece **481** is preferably disposed between the first or head portion **494** of the fastener **486** in surrounding relation to the second or shank portion **496** and in overlying relation to the elastomeric material **500**. Moreover, another metal member or piece **483** is disposed in surrounding relation with the second or shank portion **496** of the fastener **486** beneath the metal washer **481**. Preferably, member **483** includes an annular upstruck part **485** sized to extend about the shank portion **496** of the fastener **486** and designed to limit the amount the fastener **486** can be rotated in the first direction.

As will be appreciated, in response to rotation of the fastener **486**, pieces **481** and **483** are drawn toward each other while concurrently moving the insert **482** toward the interior surface of the tooth pocket or cavity **54** and away from the adapter centerline **22**. As pieces **481** and **483** move toward each other, in response to rotation of the fastener **486**, the elastomeric material **500** is squeezed and flows from between the parts **481**, **483** to preferably fill the opening **499** around a the second portion **496** of fastener **486** and the closed margin of the tool aperture **498**.

Likewise, the squeezed elastomeric material **500** along the outer surface **490** of the insert **482** tends to flow and fill tolerance variations or voids separating that area on the adapter angled side **34** immediately surrounding the recess **84** and the confronting interior surface of the tooth pocket or cavity **54**. As such, contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from reaching and adversely effecting the threaded juncture **497** between parts **482** and **486** of assembly **480**. Ultimately, rotation of the fastener **486** causes the insert **482** to be drawn into a clamping relationship with the interior surface of the tooth cavity or pocket **54** while at least a portion of the insert **482** remains within the recess or cavity **84** thereby maintaining the adapter **12** and tooth **14** in operable combination relative to each other.

FIG. **24** illustrates still another form of the present invention. In this alternative embodiment, the insert is designated generally by reference numeral **582**. The elements of this alternative hammerless attachment assembly that are functionally analogous to the components discussed above regarding attachment assembly **80** are designated by reference numerals identical to those listed above except this embodiment uses reference numerals in the 500 series.

In the embodiment illustrated in FIG. **24**, the insert **582** defines a generally centrally disposed, internally threaded bore or opening **592** and is sized to fit within the recess or cavity **84** on the side of the adapter **12**. Insert **592** includes inner and outer surfaces **588** and **590** which, in the exemplary embodiment, extend generally parallel relative to each other.

As shown in FIG. **24**, elastomeric material **600** is provided, at least, beneath the first or head portion **594** and in surrounding relation to and with a lengthwise portion or section of the threaded shank portion **596** of the fastener **586**. Notably, in the exemplary embodiment, the elastomeric material **600** extends beyond the periphery of the closed margin of the aperture or hole **98** in the tooth **14** through which the threaded shank portion **596** of fastener **586**

extends. Preferably, additional elastomeric material **600** is arranged between the outer side or surface **590** of the insert **582** and the interior surface of the tooth cavity or pocket **54** against which the insert **582** is, ultimately, to be disposed in clamping relationship therewith.

As will be appreciated, in response to rotation of the fastener **586**, the insert **582** is drawn toward the interior surface of the tooth pocket or cavity **54**. As such, and as the insert **582** begins to tighten its clamped relation with an interior surface of the blind cavity **54**, the elastomeric material **600** is squeezed between the head portion **594** and the exterior side of the tooth **14** such that contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from passing into opening **599** and along the second or shank portion **596** of the fastener **586**. Accordingly, the elastomeric material **600** inhibits such contaminants from reaching and adversely effecting the threaded juncture **597** between the parts **582** and **586** of assembly **580**.

Likewise, the pressed or squeezed elastomeric material **600** along the outer surface **590** of the insert **582** tends to flow and fill tolerance variations or voids separating that area on the adapter angled side **34** immediately surrounding the recess **84** and the confronting interior surface of the tooth pocket or cavity **54**. As such, contaminants including small rocks, stones, dirt, dirt fines, dust, and moisture are inhibited from passing between the conjoined surfaces of the adapter **12** and replacement part **14** and reaching and adversely effecting the threaded juncture **597** between parts **582** and **586** of assembly **580**. Ultimately, rotation of the fastener **586** causes the insert **582** to be drawn into a tight clamping relationship with the interior surface of the tooth cavity or pocket **54** while at least a portion of the insert **582** remains within the recess or cavity **84** thereby maintaining the adapter **12** and tooth **14** in operable combination relative to each other.

Another feature of the present invention involves configuring the attachment assembly **80** of the present invention to facilitate self-centering of the replacement part **14** on the adapter nose portion **26**. To effect such ends, the insert **82** and the insert accommodating recess or cavity **84** on the side surface of the adapter **12** define complimentary surfaces which cooperate relative to each other to stabilize the tool **14** on the adapter nose portion **26**.

In one form illustrated in FIG. **25**, a rear edge or surface **102** of the insert **82** is configured with an arc or curve **104** having a first predetermined radius. Similarly, the rear end or surface of the cavity or recess **84** in the side of the adapter nose portion **26** is configured with an arc or curvature **114** having a second predetermined radius. The first and second predetermined radiuses defined by the curves **104** and **114** either correspond relative to each other or the second predetermined radius **114** is slightly greater than the first radius **104**. As such, and as the replacement part **14** guided by the fastener **86** moves rearwardly onto the adapter nose portion **26**, the complimentary surfaces **104** and **114** serve to urge the part **14** toward a self-centered relationship relative to the adapter nose portion **26**.

In the form illustrated in FIG. **26**, a rear edge or surface **102** of the insert **82** is configured with angled camming surfaces or sides **124**, **126** which converge toward a rear end and toward a longitudinal centerline **83** of the insert **82**. Similarly, the rear end or surface of the cavity or recess **84** in the side of the adapter nose portion **26** is configured with angled camming surfaces or sides **134**, **136** which converge toward a rear end and toward a longitudinal centerline **87** of the recess or cavity **84**. The confronting camming surfaces **124**, **134** and **126**, **136** either correspond relative to each other or are disposed relative to each other to advantageously locate insert **82** within the cavity or recess **84**. As such, and as the replacement part **14** guided by the fastener **86** moves rearwardly onto the adapter nose portion **26**, the complimentary surfaces **124**, **134** and **126**, **136** serve to urge replacement part **14** toward a self-centered relationship relative to the adapter nose portion **26**.

Still another salient feature of the present invention relates to configuring the hammerlesss attachment assembly **80** of the present invention to enhance the conjuncture between the adapter **12** and the replaceable part **14** in response to rotation of the fastener **86** in a direction to affix the replaceable part **14** in operable combination with the adapter **12**. More specifically, and in a preferred embodiment, the hammerless attachment assembly **80** is designed such that the replacement part or tool **14** is urged onto the adapter nose portion **26**, thereby enhancing the conjuncture between parts **12** and **14** of the two-part digging system **10**, in response to rotation of the fastener **86** in a direction to tighten the clamping relationship between the insert **82** and the interior surface of the tooth blind cavity or pocket **54**.

As illustrated in FIG. **27**, the insert **82** is preferably configured whereby the distance separating the inner and outer surfaces **88** and **90**, respectively, is less than the distance separating the bottom surface **85** of the recess or cavity **84** from the exterior side or surface on the adapter nose portion **26** defining such recess or cavity **84**. As such, and after the replacement part **14** is initially fitted about the adapter nose portion **26**, an opening or space **81** separates the insert's outer surface **90** from the interior surface of the tool's blind cavity and against which the insert **82** is to be clamped in response to rotation of the fastener **86** so as to maintain the adapter **12** and part **14** in operable combination relative to each other.

In accordance with this aspect of the invention, the insert **82** and cavity or recess **84** in the adapter nose portion **26** define cooperative surfaces **140** and **150**, respectively, therebetween. In a preferred embodiment, surface **140** on the insert **82** is arranged in confronting relation with surface **150** on the insert accommodating recess **84**. Preferably, surfaces **140**, **150** are arranged in abutting and generally parallel relation relative to each other. In one form, the confronting surfaces **140**, **150** each extend at an acute angle ranging between about 30° and about 50° relative to the longitudinal axis **22** of the adapter nose portion **26**. In a most preferred embodiment, the confronting surfaces **140**, **150** each extend at an acute angle of about 45° relative to the longitudinal axis **22** relative to the adapter nose portion **126**.

As shown, and as discussed above, at least a lengthwise portion of the fastener **86** extends endwise through the closed marginal bore, opening, aperture, or hole **98** in the side of part **14**. As shown in FIG. **28**, and in response to rotation of the fastener **86** in a first direction about axis **93**, the insert **82** is drawn toward the interior surface of the tooth cavity or pocket **54**. As such, the space **81** between the outer surface **90** of the insert **82** and the interior surface of the tooth cavity or pocket **54** reduces while concurrently therewith surface **140** on the insert **82** is guided along confronting surface **150** on the adapter nose portion **26**. As surface **140** on the insert **82** is guided and moves along confronting surface **150** on the adapter nose portion **26** in response to tightening of the fastener **86**, the insert **82** forcibly moves or drives the fastener **86** in the direction of the arrow **160** in FIG. **28**. With at least a lengthwise portion of the fastener **86** being entrapped within the tool's closed marginal bore **98**,

the forced movement of the fastener **86** effects corresponding endwise movement of the tool **14** in the direction of the arrow **160** thereby forcing tool **14** onto the adapter nose portion **26**, thus, enhancing the conjuncture therebetween.

In that embodiment illustrated in FIGS. **27** and **28**, an exterior side or surface of the replacement part or tool **14** is preferably configured or contoured with a raised area **164** in advance of the fastener head portion **94**. As such, a major portion or section of the fastener head portion **94** is protected against ground engaging abrasives acting to wear down or reduce the first or head portion **94** of the fastener **86** during operation of the two-part digging system **10**.

With the attachment assembly of the present invention, the heretofore known problems associated with elongated pinning systems is eliminated. More specifically, the attachment assembly of the present invention is essentially hammerless in operation. That is, the present invention eliminates requiring an operator to forcibly pound and, thus, move an elongated retaining element to effect repair/replacement of part **14** of the two-part digging system. With the present invention, repair and/or replacement of the tool **14** is quickly and easily facilitated in an optimum manner simply by rotating the fastener **86** about axis **93** to release the connection between parts **82** and **86** of the attachment assembly **80** thereby readily allowing for repair/replacement of part **14**. After part **14** has been repaired/replaced, fastener **86** is reinserted through hole **98** in part **14** and into threaded engagement with insert **82** to again releasably secure adapter **12** and part **14** in operable combination with each other.

Moreover, the design of the attachment assembly of the present invention is inherently stronger than other heretofore known replaceable part systems. That is, the attachment assembly **80** requires only a recess **84** to be provided on the exterior side of the adapter nose portion **26** rather than an elongated bore extending completely therethrough. As will be appreciated, the recess or cavity **84** adds significantly to the overall strength of the adapter nose portion by eliminating a throughbore extending from one side of the adapter nose portion to the other. Using a recess or cavity rather than bore which opens at opposite ends thereof furthermore eliminates inherent "run out" problems associated with such bores.

With the present invention, the threaded juncture **87** between parts **82** and **86** of assembly **80** is designed to facilitate release of the attachment assembly notwithstanding exposure of the two-part digging system to environmental conditions which would normally cause corrosion, oxidation, rusting and deterioration of the operative junction between the parts. In one form of the invention, the insert **82** of the attachment assembly **80** is fabricated from a corrosion resistant non-ferrous metal, thus, concerns over corrosion of the threaded juncture between the component parts **82** and **86** is eliminated.

Alternatively, elastomeric material is arranged in operable combination with the insert **82** and the rotatable fastener **86** to inhibit contaminants from adversely effecting the threaded juncture **87** between such parts of the hammerless attachment assembly. In another form of the invention, the elastomeric material extends along at least the entire lengthwise section of the externally threaded shank portion **96** of the fastener **86** extending through the insert **82**. The elastomeric material can be configured as part of the insert and can define the internally threaded bore **92** while having an exterior configuration to inhibit separation of the elastomeric material from insert **82** as said insert **82** is drawn toward and, ultimately, clamped against an interior side surface of the blind cavity or pocket **54** defined by the replaceable tool **14**.

Suffice it to say, the elastomeric material arranged in combination with the components parts **82** and **86** of the attachment assembly **80** limits adverse effects of contaminants on the threaded juncture **87** whereby facilitating rotation of the fastener **86** in a direction to effect release of the replaceable part **14** from operable combination with the adapter **12**. Additionally, and in that embodiment of the invention wherein the elastomeric material is arranged in surrounding relation relative to the insert **82**, the elastomeric material will naturally tend to offer shock and impact resistence to the connection which releasably maintains the adapter and part **14** in operable combination relative to each other.

The design of the attachment system **80** according to the present invention is particularly beneficial when arranged in combination with a two-part digging system wherein the juncture between the nose portion **26** of the adapter **12** and the replaceable part **14** has a rhombus-like cross-section. According to still another aspect of the invention, and although arranged or offset to one side thereof, the attachment assembly **80** is configured to facilitate stabilization between the nose portion **26** of the adapter **12** an the tool **14**. In a preferred embodiment, the insert **82** and the recess or pocket **84** defined on the side surface of the adapter **12** define complimentary surfaces which cooperate relative to each other to center the tool **14** on the nose portion of the adapter **12** thereby advantageously effecting the connection therebetween.

Yet another advantageous feature of the present invention relates to the ability of the attachment assembly **80** to enhance the conjuncture between the adapter **12** and tool **14** by urging the tool **14** onto the nose portion **26** of the adapter **12** in response to the fastener **86** being rotated in a direction to tighten the clamping relationship of the insert **82** against the interior surface of the blind cavity **54** defined by the tool **14**. To effect such ends, the rotatable fastener **86** of the attachment assembly **80** includes a lengthwise portion for engaging a closed margin of the opening or aperture **98** in the side of the replacement part **14** through which the fastener **86** extends. Moreover, the insert **82** and the insert accommodating recess **84** on the nose portion **26** of the adapter **12** define surfaces **140** and **150**, respectively, which cooperate relative to each other as the insert **82** is drawn toward the interior surface of the cavity, in response to rotation of the fastener **86**. The surfaces **140**, **150** cause the insert **82** and, ultimately, the replacement part **14** to move rearward in a direction extending generally parallel to the longitudinal axis **22** of the adapter **12** thereby enhancing the tightness of the conjuncture between the interior surfaces of the blind cavity **54** and the adapter nose portion **26**.

From the foregoing it will be observed numerous modifications and variations can be effected without departing or detracting from the true spirit and novel scope of the present invention. It will be appreciated, the present disclosure is intended to set forth exemplifications of the invention which are not intended to limit the invention to the specific embodiments illustrated. The disclosure is intended to cover by the appended claims all such modifications and variations as fall within the spirit and scope of the claims.

What is claimed is:

1. A hammerless attachment assembly for releasably maintaining a ground engaging tool and an adapter in operable combination relative to each other, with said ground engaging tool defining an open ended blind cavity between multiple sides, said hammerless attachment assembly comprising:

an insert nonrotatably fitted within a recess defined on a side of a nose portion of said adapter, said insert defining an internally threaded bore;

a rotatable fastener having a head portion and an externally threaded shank portion, said shank portion of said fastener being sized to extend lengthwise through an opening having a closed margin defined in a side of said tool, with the opening in the side of said tool generally aligning with the internally threaded bore in said insert when said tool is positioned on the nose portion of the adapter, and with the externally threaded shank portion of said fastener forming a threaded juncture with the internally threaded bore on the insert such that, in response to rotation of said fastener in a first direction, said insert is drawn toward and ultimately moved into clamping relation with an interior side surface of said blind cavity while remaining, at least partially, within said recess, thereby releasably maintaining said tool and adapter in operable combination relative to each other; and

wherein elastomeric material is disposed in operable combination with said rotatable fastener and said insert for inhibiting contaminants from adversely effecting said threaded juncture whereby facilitating rotation of said fastener in a direction opposed to said first direction when said tool is to be released from operable combination with said adapter.

2. The hammerless attachment assembly according to claim **1** wherein said insert and the recess defined on the side surface of the adapter define complimentary surfaces which cooperate relative to each other to stabilize the tool on the nose portion of the adapter.

3. The hammerless attachment assembly according to claim **1** wherein said elastomeric material is configured as part of said insert and defines the internally threaded bore thereof, with said elastomeric material having an exterior configuration which inhibits separation of said elastomeric material from insert as said insert is drawn toward and ultimately moved into clamping relation with an interior side surface of said blind cavity defined by said tool.

4. The hammerless attachment assembly according to claim **3** wherein said elastomeric material extends along at least the entire lengthwise section of said externally threaded shank portion of the fastener extending through said insert.

5. The hammerless attachment assembly according to claim **1** wherein said insert includes inner and outer surfaces, with said inner surface of said insert being arranged in confronting relation relative to said adapter and with said outer surface of said insert being arranged adjacent an interior side surface of the blind cavity defined by said tool after said fastener is rotated to draw said insert into clamping relationship with the interior side surface of the blind cavity defined by said tool.

6. The hammerless attachment assembly according to claim **5** wherein said elastomeric material is disposed between an outer surface of said insert and said interior side of said blind cavity and extends into operable surrounding relation with said externally threaded shank portion of said fastener thereby inhibiting contaminants from getting through to said threaded juncture between said fastener and said insert.

7. The hammerless attachment assembly according to claim **6** wherein said elastomeric material has a Shore A hardness ranging between about 50 and about 80.

8. The hammerless attachment assembly according to claim **1** wherein said insert comprises a first part defining said internally threaded bore and a second part arranged in operable engagement with said first part.

9. A hammerless attachment assembly for releasably maintaining a ground engaging tool and an adapter in operable combination relative to each other, with said ground engaging tool defining an open ended blind cavity between multiple side surfaces, said hammerless attachment assembly comprising:

an insert nonrotatably fitted within a recess defined on a side surface of a nose portion of said adapter, said insert defining an internally threaded bore;

a rotatable fastener having a head portion and an externally threaded shank portion, said shank portion of said fastener being sized to extend lengthwise through an opening having a closed margin defined in a side of said tool, with the opening in the side wall of said tool generally aligning with the internally threaded bore in said insert when said tool is positioned onto the nose portion of the adapter, and with the externally threaded shank portion of said fastener forming a threaded juncture with the internally threaded bore on the insert such that, in response to rotation of said fastener in a first direction, said insert is drawn toward and ultimately moved into a clamping relationship relative to an interior side surface of said blind cavity while remaining, at least partially, within said recess thereby releasably maintaining said tool and adapter in operable combination relative to each other; and

wherein said insert is formed from a corrosion resistant nonferrous material whereby facilitating rotation of said fastener in a direction opposed to said first direction when said tool is to be released from operable combination with said adapter.

10. A hammerless attachment assembly for releasably maintaining a two-part digging tooth assembly including a ground engaging tooth and an adapter in operable combination relative to each other, said adapter including a free ended nose portion having a longitudinal axis and including multiple exterior surfaces, and with said ground engaging tool defining an open ended blind cavity between multiple side surfaces for allowing said tooth to fit about and lengthwise along said nose portion of the adapter, said hammerless attachment assembly comprising:

a first part nonrotatably fitted within a recess defined on one of said exterior surfaces of said nose portion of said adapter;

a rotatable second part operably associated with said first part, with a lengthwise portion of said second part extending through an opening in one of said sides of the tooth and forming an operative juncture with said first part, and wherein, in response to rotation of said second part in a first direction said tooth and said adapter are releasably clamped to each other as through the attachment assembly thereby releasably maintaining said tooth and adapter in operable combination relative to each other; and

wherein elastomeric material is disposed in operable combination with said first and second parts for inhibiting contaminants from getting through to said operative juncture whereby facilitating rotation of said second part in a direction opposed to said first direction when said tooth is to be released from operable combination with said adapter.

11. The hammerless attachment assembly according to claim **10** wherein said first part is an insert having an internally threaded bore, and wherein said second part is a threaded fastener which combines with said insert to releasably maintain said adapter and said tooth in operable combination relative to each other.

12. The hammerless attachment assembly according to claim **11** wherein said insert and the recess defined on the

side surface of the adapter define complimentary surfaces which cooperate relative to each other to stabilize the tooth on the nose portion of the adapter.

13. The hammerless attachment assembly according to claim **11** wherein said elastomeric material is disposed between said insert and a confronting interior side of said blind cavity and extends into operable surrounding relation with an externally threaded shank portion of said fastener thereby inhibiting contaminants from getting through to said operative juncture between said first and second parts of said attachment assembly.

14. The hammerless attachment assembly according to claim **10** wherein said elastomeric material has a Shore A hardness ranging between about 50 and about 80.

15. The hammerless attachment assembly according to claim **10** wherein said first part is a metal insert having inner and outer sides disposed at different distances from the longitudinal centerline of the nose portion of said adapter, with the inner side of said insert being arranged in closer proximity to the longitudinal centerline of the nose portion of said adapter than is said outer side of said insert, and wherein said insert and said adapter include cooperating angularly ramped surfaces which enhance the conjuncture between said tooth and adapter in response to the outer surface of said insert being drawn toward and into clamping relationship with the interior surface of said blind cavity.

16. A hammerless attachment assembly for a two-part digging tooth system including an adapter having an elongated nose portion about which a digging tooth is lengthwise fitted in relatively snug relationship therewith, said adapter having top and bottom surfaces, with the top surface of the nose portion of said adapter having two angled sides disposed on opposite lateral sides of a longitudinal centerline of said nose portion of said adapter, with said tooth defining a blind cavity open to a rear end of the tooth and formed by sides of the tooth, and wherein a cross section of said cavity is complimentary in shape to a corresponding cross section of the nose portion of said adapter, with said hammerless attachment assembly comprising:

an insert nonrotatably fitted within an open top recess disposed toward a rear of said nose portion and is generally centered on an angled side of the top surface of the nose portion of said adapter, with said insert defining an internally threaded bore, and wherein said recess defines an axis extending generally normal to the side surface to which said recess opens;

a rotatable fastener having a head portion and an externally threaded shank portion, said shank portion of said fastener being sized to extend lengthwise through an opening having a closed margin defined in a side of said digging tooth, with the opening in the side of said digging tooth generally aligning with the internally threaded bore in said insert when said tooth is positioned on the nose portion of the adapter, and with the externally threaded shank portion of said fastener forming a threaded juncture with the internally threaded bore on the insert such that, in response to rotation of said fastener in a first direction, said insert is drawn toward and ultimately moved into clamping relation with an interior side surface of said blind cavity while remaining, at least partially, within said recess, thereby releasably maintaining said tool and adapter in operable combination relative to each other; and

wherein elastomeric material is disposed in operable combination with said rotatable fastener and said insert for limiting adverse effects of contaminants on said threaded juncture whereby facilitating rotation of said fastener in a direction opposed to said first direction when said tool is to be released from operable combination with said adapter.

17. The hammerless attachment assembly according to claim **16** wherein said insert and the recess defined on the side surface of the adapter define complimentary surfaces which cooperate relative to each other to stabilize the tooth on the nose portion of the adapter.

18. The hammerless attachment assembly according to claim **16** wherein said elastomeric material is configured as part of said insert and defines the internally threaded bore thereof, with said elastomeric material having an exterior configuration which inhibits separation of said elastomeric material from insert as said insert is drawn toward and ultimately moved into clamping relation with an interior side surface of said blind cavity defined by said tooth.

19. The hammerless attachment assembly according to claim **18** wherein said elastomeric material extends along at least the entire lengthwise section of said externally threaded shank portion of the fastener extending through said insert.

20. The hammerless attachment assembly according to claim **18** wherein said insert includes inner and outer surfaces, with said inner surface of said insert being arranged in confronting relation relative to said adapter and with said outer surface of said insert being arranged adjacent an interior side surface of the blind cavity defined by said tooth after said fastener is rotated to draw said insert into clamping relationship with the interior side surface of the blind cavity defined by said tooth.

21. The hammerless attachment assembly according to claim **20** wherein said elastomeric material is disposed between an outer surface of said insert and said interior side of said blind cavity and extends into operable surrounding relation with said externally threaded shank portion of said fastener thereby inhibiting contaminants from getting through to said threaded juncture between said fastener and said insert.

22. The hammerless attachment assembly according to claim **16** wherein said insert comprises a first part defining said internally threaded bore and as second part arranged in operable engagement with said first part.

23. A hammerless attachment assembly for releasably maintaining a ground engaging tooth and an adapter in operable combination relative to each other, said adapter including a free ended nose portion having a longitudinal axis and including multiple exterior surfaces, and with said ground engaging tooth defining an open ended blind cavity between multiple sides for allowing said tooth to fit about and lengthwise along said nose portion of said adapter, said hammerless attachment assembly comprising:

an insert nonrotatably fitted within a recess defined on an exterior surface of the nose portion of said adapter, said insert defining an internally threaded bore;

a rotatable fastener having a head portion and an externally threaded shank portion, with said shank portion being sized to extend lengthwise through an opening in one of said sides of the tooth and threadably engage with the internally threaded bore of said recess while having a portion of said fastener engaging a closed margin of said opening defined by one of said sides of said tooth, and such that, in response to rotation of said fastener in a first direction, said insert is drawn away from the longitudinal axis of said nose portion of the adapter and ultimately moved into clamping relation with an interior side surface of said blind cavity while remaining, at least partially, within said recess, thereby releasably maintaining said tooth and adapter in operable combination relative to each other; and

wherein said insert and the recess in the nose portion of said adapter define confronting surfaces which cooperate relative to each other as said insert is drawn away from the longitudinal centerline of said adapter to axially move said tooth toward a rear end of the nose portion of said adapter thereby enhancing a conjuncture between the cavity in said tooth and the exterior surfaces on the nose portion of the adapter.

24. The hammerless attachment assembly according to claim **23** wherein the confronting surfaces defined on said adapter and said insert are arranged in generally parallel relation relative to each other.

25. The hammerless attachment assembly according to claim **23** wherein the confronting surfaces defined on said adapter and said insert each extend at an acute angle ranging between about 30° and about 50° relative to the longitudinal axis of the nose portion of said adapter.

26. The hammerless attachment assembly according to claim **23** wherein the confronting surfaces defined on said adapter and said insert each extend at an acute angle of about 45° relative to the longitudinal axis of the nose portion of said adapter.

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